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ABSTRACT

This curriculum guide is intended to assist teachers, administrators, and supervisors in organizing and conducting vocational programs which meet the needs of high school students who desire vocational training in the off-farm agribusiness of agricultural machinery service. The three-year course for grades 10, 11, and 12 involves operation, maintenance, set-up, adjustement, repair, reconditioning, and overhaul of agricultural machinery and equipment. It includes dealership organization, management, sales, human relations, and leadership development topics. Study of career opportunities and development of job experience through supervised occupational experiences are also a part of the program. Designed for 1080 hours of in-school instruction (360 per year), the course needs two consecutive periods per day for class instruction. Each of the three years is divided into 8-10 major learning areas which are organized into this format: (1) unit concept, (2) suggested student performance objectives, (3) instructional areas, (4) examples of student learning activities, (5) competencies, (6) instructional materials, and (7) supporting references. A list of 100 references is provided. Other materials include a list of recommended equipment, recommended facility plans, and criteria for quality vocational programs in agricultural education. (YLB)

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ED200792

# Agricultural Machinery Service

## A CURRICULUM GUIDE FOR AGRICULTURAL EDUCATION

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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## FOREWORD

Agricultural Education was established in the public schools of Virginia after the passage of the Smith-Hughes Act of 1917. The primary objective during the early years of the program was to provide the training needed by established and prospective farmers. Agricultural technology and mechanization, along with the high degree of specialization required on Virginia farms, has resulted in many agricultural jobs being moved to the off-farm segment of the industry.

From the passage of the Vocational Education Act of 1963, as amended in 1968 and the subsequent Act of 1976, agricultural education was charged with the responsibility of providing the vocational training needed in the on-farm and off-farm segments of the industry of agriculture. This has presented many new challenges and opportunities to teachers of agriculture and local programs of vocational education. The training of students in the field of agricultural machinery service is one of the off-farm agribusiness segments requiring vocational training at the secondary level.

Mechanization in agriculture is one of the primary reasons we have been able to produce more food and fiber with fewer people. This mechanization has brought with it an increased need for persons to service machines and equipment being used on farms, in agribusiness establishments, on home lawns and gardens and other agricultural applications.

The goals of this course are to prepare students with job entry and/or marketable skills in the field of agricultural machinery service, provide students with a broad base of experiences and information upon which they can make intelligent career choices and contribute to the fulfillment of the broad educational objectives set forth for students in their respective high schools.

This curriculum guide is intended to assist teachers, administrators and supervisors in organizing and conducting vocational programs which meet the needs of high school students who desire vocational training in the off-farm agribusiness of agricultural machinery service.

S. JOHN DAVIS
*Superintendent of Public Instruction*

# OVERVIEW OF THE COURSE OUTLINE FOR AGRICULTURAL MACHINERY SERVICE

I. Definition

Agricultural Machinery Service is a secondary vocational course which involves the operation, maintenance, set-up, adjustment, repair, reconditioning and overhaul of agricultural machinery and equipment. The course includes dealership organization, management, sales, human relations, and leadership development topics. The study of career opportunities and the development of job experience through supervised occupational experiences are also a part of this program.

II. Purposes

The primary purposes of the Agricultural Machinery Service course of study are to:

A. provide students job entry and/or marketable skill training in agricultural machinery and related occupations;
B. provide students a broad base of occupational experiences and information upon which they can make a career decision;
C. Contribute to the fulfillment of the broad educational objectives set forth in the high schools where this course is taught.

III. Objectives

The objectives of the Agricultural Machinery Service course are to:

A. experience and develop a knowledge of career opportunities;
B. acquire job experience through planning and conducting occupational experience programs;
C. promote an understanding of the organization and management of agricultural machinery dealerships;
D. develop leadership potential and human relation skills;
E. develop machinery service skills with sufficient competency that leads to gainful employment;
F. develop safe work habits and attitudes;
G. contribute to the fulfillment of the general educational objectives of the high school where this course is taught;
H. relate specialized knowledge and develop technical skills in machinery operation, maintenance; repair and overhaul;
I. provide a foundation for post-high school education in agriculture.

IV. Enrollment Guidelines For Students

The three year course in machinery services is designed for students in the 10th, 11th, and 12th grades. Agricultural Science and Mechanics I and II are considered to be prerequisites for enrollment in the machinery service course. Students satisfactorily completing the second sequential year of the course are considered to be program completions.

V. Occupational Experience Program

Each student is required to carry out a well planned and supervised occupational experience program as an integral part of the course expectations. Experiences may be provided in the school mechanics laboratory, on farms, in nearby farm equipment businesses, or by a combination of these sources. It is recommended that students complete one year of the course prior to placement in work experience programs. It is desirable that students be placed in an agricultural machinery business on a cooperative work experience program during the final year of the course. The time necessary for conducting and coordinating occupational experience programs is considered to be in addition to in-school instructional time.

VI. Hours of Instruction

Agricultural Machinery Service is a course designed for 1080 hours of in-school instruction. Each year of the course needs 360 hours for completion with two consecutive periods per day needed for instruction in each class. In situations where these hours cannot be met, it is recommended that teachers select units of instruction from this guide which best fit community and student needs.

VII. Advisory Groups

An advisory council consisting of local machinery dealers, farmers, school administrators, parents and other interested persons should be formed to assist in establishing and conducting this program. The advisory council should make recommendations relative to course establishment, curriculum content, facility and equipment needs, occupational experience programs, placement, youth organization activities, etc.

## AGRICULTURAL MACHINERY SERVICE III

| *Major Learning Areas* | *Time Estimate Hrs.* |
|---|---|
| I. Orientation | 10 |
| II. Career Opportunities | 10 |
| III. Supervised Occupational Experience Programs | 20 |
| IV. Leadership Training and/or FFA Activities | 40 |
| V. Small Engine Reconditioning, Repair, and Overhaul | 60 |
| VI. Tractor Operation, Maintenance, and Engine Analysis | 100 |
| VII. Equipment Set-Up, Adjustment, Operation, and Maintenance | 100 |
| VIII. Evaluation/Testing | 20 |
| | 360 |

## I. ORIENTATION

UNIT CONCEPT: Proper organization of students and shop jobs, in relation to safety, inventory housekeeping, etc., will provide a meaningful experience to students enrolled in Agricultural Machinery Service programs.

### A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

1. To establish at the beginning of the course, the expected behavior of students in relation to various shop procedures and policies.

### B. INSTRUCTIONAL AREAS

1. General Safety
2. Inventory Control
3. Housekeeping
4. Department Policies
5. Student Group Assignments
6. Locker, Tool, and Coverall Assignments
7. Job Billing Procedures
8. Specific Equipment Operation
   a. Procedures
   b. Safety Testing
9. Reviewing Course Objectives and Content
10. Reviewing Course Evaluation Procedures

### C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Demonstrate proper use of fire extinguisher
2. Inventory tools for which students will be responsible.
3. Discuss various department policies and procedures

### D. COMPETENCIES

1. Practicing laboratory safety
   Wear and use personal protective equipment
   Identify safety rules and regulations established for power tools and equipment operation in the laboratory
   Operate equipment safely
   Store combustibles safely
   Select and use fire extinguishers
   Secure first aid assistance in case of accident
   Interpret safety signs, symbols and color codes

2. Maintaining inventory control
   - Order inventory items
   - Record inventory items
   - Receive and stock inventory items
3. Maintaining clean and orderly work area
   - Organize jobs to be completed
   - Store parts neatly
   - Store tools
   - Clean work area
4. Following departmental policies
   - Participate in group assignments
   - Use job billing procedures

E. INSTRUCTIONAL MATERIALS
1. Selected Handouts

F. SUPPORTING REFERENCES

1. *Power Tool Safety & Operation*—HOBAR Publications, Inc., Ref. No. 41
2. *Modern Agricultural Mechanics*—Wakeman, Ref. No. 109.
3. *Agriculture Shop Safety*—Clemson University, Ref. No. 17.

## II. CAREER OPPORTUNITIES

UNIT CONCEPT: The field of agricultural machinery service includes a broad spectrum of career opportunities the student may wish to explore. By studying the various occupations, the student will be able to consider factors that may influence the choice of a career.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

1. Upon completion of this unit, the student will correctly identify eight occupations within an agricultural machinery dealership.
2. Given a specific agricultural machinery service career in which the student is interested, the student will determine the competencies and requirements needed for entry and advancement in that career.
3. The student will list correctly four occupations outside an agricultural machinery dealership that require similar skills and knowledge to those needed for agricultural machinery dealership occupations.

B. INSTRUCTIONAL AREAS

1. Identifying job titles related to an agricultural machinery dealership.
   a. Management Occupations
      1. Dealer/Manager
      2. Sales Manager
      3. Parts Manager
      4. Service Manager
      5. Credit Manager
   b. Sales Department Occupations
      1. Sales person
      2. Sales Trainee
   c. Parts Department Occupations
      1. Parts clerk
      2. Parts Stock clerk
      3. Parts Helper
   d. Service Department Occupations
      1. Agricultural Equipment Mechanic
      2. Agricultural Equipment Mechanic's Helper
      3. Agricultural Equipment Set-up and Delivery person
      4. Agricultural Equipment Field and Maintenance person

2. Classifying Careers as to Occupational Level
   1. Professional
   2. Technical
   3. Service

3. Identifying Major Competencies Needed for Each Occupation
   1. Entry Level
   2. Advancement

4. Identifying Educational Requirements and Sources of Training
   1. High School
   2. Post-secondary Occupational-Technical
   3. College
   4. Company or Manufacturer Schools

5. Identifying Characteristics of Each Occupation
   1. Salary
   2. Working Conditions
   3. Light or Heavy Work
   4. Indoor or Outdoor Work
   5. Seasonal Work
   6. Type of Contact Made with Fellow Employees and Clientele

6. Identifying Job Opportunities Outside an Agricultural Machinery Dealership
   1. Production Agriculture
      a. Farm Equipment Operator
      b. Mechanic on a Large Farm
   2. Business
      a. Garden Center Equipment Mechanic or Operator
      b. Industrial Equipment Mechanic or Operator
   3. Self-Employment Opportunities
      a. Business
      b. Repair Shop Operator
      c. Other

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES
   1. Interview several persons in specific agricultural machinery service occupations to determine the competencies and requirements needed to enter the occupations.
   2. Visit the owner or manager of a large farm and discuss the factors considered in hiring an employee with agricultural machinery training.

D. COMPETENCY
   1. Selecting a career
      Identify jobs in a machinery service dealership
      Identify jobs in machinery service other than a dealership

E. INSTRUCTIONAL MATERIALS
   1. Written notices from newspapers, journals (Implement and Tractor Magazine), and other publications listing various related job openings.

F. SUPPORTING REFERENCES
   1. *There's A Future Here, Will You Be In It?*, Ref. No. 46.
   2. *Handbook of Agricultural Occupations*, Ref. No. 42.

## III. SUPERVISED OCCUPATIONAL EXPERIENCE PROGRAMS

UNIT CONCEPT: The occupational experience program provides each student the opportunity to apply what has been learned in the classroom and laboratory. Given this system, all students should plan and conduct, under the supervision of their instructor,

a program of application experiences, commensurate with their instruction, personal interest and community resources. Experience gained in conducting an occupational experience program should lead to developing a saleable skill usable in the agricultural machinery and/or a related industry.

## A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

The student should be able to:

1. survey local occupational situations and literature to determine the number and kind of job opportunities that are available in agricultural machinery service.
2. develop an annual plan of occupational experiences satisfactory to the student and the instructor.
3. prepare an occupational experience agreement satisfactory to the student and the instructor.

## B. INSTRUCTIONAL AREAS

1. Planning the Supervised Occupational Experience Program
   a. Planning activities that will enable the students to be exposed to experiences which will aid in their employment.
   b. Writing occupational experience program agreements.
   c. Keeping records of occupational experience activities.
   d. Supervising and evaluating the students occupational experience program.
2. Summarizing and Evaluating Occupational Experience Program Records
3. Applying for FFA Proficiency Awards
   a. Selecting appropriate proficiency awards for which to apply
   b. Explaining types of information needed for the application
   c. Summarizing and transferring records from the record book
   d. Filling out the application.

## C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

Complete a Proficiency Award Application

## D. COMPETENCY

Securing occupational experience:

1. plan a supervised occupational experience program;
2. complete a supervised occupational experience program;

3. record and analyze occupational experience program records;
4. apply for proficiency awards.

E. INSTRUCTIONAL MATERIALS

Record books, proficiency award applications, job application forms.

F. SUPPORTING REFERENCES

1. *FFA Advisors' Handbook*, Ref. No. 25
2. *Agricultural Equipment and Mechanics Curriculum Guide*, Ref. No. 105.
3. *How to Find and Apply for a Job*, Ref. No. 67.

## IV. LEADERSHIP TRAINING AND/OR FFA ACTIVITIES

UNIT CONCEPT: Active participation in the FFA will provide the student opportunities for developing practical training in agriculture, leadership, cooperation, and citizenship.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

The student should be able to:

1. actively participate in the FFA Chapter's business meeting and demonstrate the principles of parliamentary procedure as presented in Robert's Rules of Order, Revised, or other acceptable references;
2. present an oral presentation to the class which is acceptable to the instructor;
3. demonstrate ability to serve effectively on a panel discussion to the satisfaction of the instructor;
4. identify the kinds of group meetings and when they should be used.

B. INSTRUCTIONAL AREAS

1. Reviewing Parliamentary Procedure
2. Participating in FFA and other orgainizations
   a. Identifying FFA and other award programs
   b. Conducting a Public Relations Program
      (1) Writing news articles
      (2) Making radio and television programs
      (3) Making pictures for exhibits and news media

(4) Speaking to special groups

c. Participating in committee activities

(1) Serving as committee chairperson

(a) Planning a committee meeting

(b) Conducting a committee meeting

(c) Preparing and delivering an oral report

(2) Serving as committee secretary

(a) Writing minutes

(b) Reading minutes and securing approval or corrections

## C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Participate in classroom study and practice of parliamentary procedure to develop skills in conducting and carrying on meetings.
2. Serve as a committee chairperson to develop leadership skills.
3. Make a radio and/or television program.
4. Preparing a committee written and/or oral report

## D. COMPETENCY

Developing leadership skills:

1. Conduct a meeting using accepted parliamentary procedures.
2. Know duties of all officers in the youth organization.
3. Present an oral delivery using accepted public speaking techniques.
4. Participate on a panel discussion.
5. Conduct a panel discussion.
6. Write a news release.
7. Conduct a committee meeting.
8. Participate in FFA committee activities.

## E. INSTRUCTIONAL MATERIALS

FFA paraphenalia, FFA Thrust 75 slides and tapes.

## F. SUPPORTING REFERENCES

1. *Robert's Rules of Order*, Ref. No. 90
2. *Official FFA Manual*, Ref. No. 28.
3. *Virginia FFA Activity Handbook*, Ref. No. 39.
4. *FFA Leadership Handbook*, Ref. No. 71.

## V. SMALL ENGINE RECONDITIONING, REPAIR, AND OVERHAUL

UNIT CONCEPT: In recent years the use of small engines has shown remarkable growth among farmers and non-farmers. Small engines serve as a power source for chain saws, lawn mowers, portable pumps, roto-tillers and a variety of other agriculture applications. The ability of the student to adjust, maintain, repair and overhaul a small gasoline engine represents an important occupational experience.

A. STUDENT PERFORMANCE OBJECTIVES

1. Given a small engine, the student will correctly service and maintain it.
2. When provided with an engine that is not operating properly, the student will follow the procedural steps in troubleshooting to diagnose the difficulty and repair the engine if necessary.
3. The student will properly prepare a small engine for storage.

B. INSTRUCTIONAL AREAS

1. Operating Principles of Small Engines
   a. Four-stroke cycle
   b. Two-stroke cycle
2. Small Engine Safety
3. Measuring and Testing Instruments
   a. Identifying measuring and testing instruments
      (1) micrometer caliper
      (2) thickness gauges
         (a) feeler gauge
         (b) round-wire gauge
         (c) reject gauge
         (d) plastigauge
      (3) dial indicator
      (4) torque wrench
      (5) compression tester
      (6) tachometer
      (7) cylinder testing gauges
   b. Determining the function of measuring and testing instruments

4. Compression System
   a. Determining the functions of the parts in the compression system
      (1) power conversion components
         (a) crankshaft
         (b) flywheel
         (c) connecting rod
         (d) bearings
         (e) piston
         (f) rings
      (2) valve assembly
         (a) camshaft
         (b) valves
   b. Defining terms of the compression system
      (1) piston displacement
      (2) compression ratio
      (3) top dead center (TDC)
      (4) bottom dead center (BDC)
   c. Lubricating the compression system components
      (1) four-stroke cycle
      (2) two-stroke cycle
   d. Identifying defects in the compression system
      (1) identifying defects in the cylinder
      (2) identifying defects in the cylinder head
      (3) identifying defects in the crankshaft and connecting rod
      (4) identifying defects in the value assembly
   e. Correcting problems in the compression system
      (1) repairing or servicing the cylinder and head
         (a) clean carbon deposits from the cylinder head
         (b) remove cylinder wall ridges
         (c) deglaze cylinder wall
      (2) servicing the piston and rings
         (a) install rings on piston
         (b) install piston assembly in engine block
      (3) servicing the connecting rod and crankshaft
         (a) install wrist pin and connecting rod on piston
         (b) install the crankshaft
      (4) repairing or servicing the valve assembly
         (a) lap intake and exhaust valves
         (b) adjust valve tappet clearance
5. Ignition System
   a. Determining the functions of the components of the magneto ignition system

(1) components of the primary circuit
(2) components of the secondary circuit

b. Identifying defects in the magneto ignition system
(1) inspecting for loose connections
(2) checking the condition of the spark plug and measuring the spark plug gap
(3) checking the condition of the flywheel key and measuring the armature air gap
(4) inspecting the condition of the breaker points and push rod
(5) measuring the point gap setting
(6) checking ignition timing
(7) checking condenser and coil with a tester

c. Correcting problems in the magneto ignition system
(1) servicing the spark plug
(a) determining appropriate spark plug to install
(b) adjusting spark plug gap
(2) installing the proper flywheel key
(3) adjusting the armature air gap
(4) servicing the breaker points and condenser
(a) installing breaker points and condenser
(b) adjust breaker point gap
(c) inspecting contact between breaker point surfaces
(5) timing the magneto by moving the stator plate

d. Determining the functions of the components of the solid state ignition system

6. Carburetion System

a. Determining the functions of the components of the carburetion system
(1) carburetor
(2) governor
(3) air cleaner

b. Determining the purposes of the parts of the carburetor
(1) venturi
(2) throttle
(3) choke
(4) types of carburetors
(5) carburetor adjustments

c. Identifying defects in small engine carburetion systems
(1) inspecting for throttle shaft wear
(2) inspecting high and/or low speed adjusting needles, seats, and/or fuel nozzles
(3) inspecting gaskets, "O" rings, and fuel pump diaphram

(4) inspecting fuel lines and sediment bowl
(5) inspecting the air cleaner element
(6) inspecting governor, governor linkage, and throttle linkage

d. Correcting problems in the carburetion system
(1) servicing the fuel tank and gasoline supply line
(2) servicing the air cleaner
(3) adjusting governor and throttle linkages
(4) repairing the carburetor
(5) making final adjustments on low speed and high speed adjustment screws
(6) adjust the idle stop screw

7. Preventive Maintenance
a. Fuels and fuel system
(1) selecting and storing fuel
(2) servicing the fuel system
b. Lubrication system
(1) selecting crankcase oil
(a) API classifications
(b) SAE viscosity ratings
(2) changing crankcase oil
c. Cleaning the cooling system
d. Cleaning the crankcase breather
e. Servicing the air cleaner
(1) oil bath air cleaner
(2) oil foam air cleaner
(3) dry element air cleaner
f. Servicing the magneto ignition system
(1) breaker points and condenser
(2) coil
(3) armature air gap
(4) spark plug
g. Adjusting valve tappet clearance
h. Adjusting the carburetor air/fuel mixture
i. Adjusting governor linkage
j. Cleaning the engine

8. Economics of small engine overhaul
a. Availability of service manual
b. Availability of replacement parts
c. Cost of replacement parts versus cost of new engine
d. Labor costs for overhaul

9. Disassembly and reassembly of small engines
a. Disassembling according to service manual procedures

b. Cleaning the disassembled parts
c. Inspecting and measuring the disassembled parts
d. Determining need for replacement parts based on service manual specifications
e. Reassembly according to service manual procedures
f. Measuring horsepower to judge the value of the overhaul

10. Off-Season Storage
    a. Short term storage
        (1) dry environment
        (2) fuel tank full
        (3) spark plug wire disconnected
    b. Long term storage
        (1) drain fuel system and carburetor
        (2) change crankcase oil
        (3) lubricate cylinder wall
        (4) clean engine cooling fins
        (5) oil all pivot points
        (6) remove spark plug wire
    c. Returning engine to service
11. Small Engine Analysis and Trouble Shooting
    a. Using an engine analysis checklist
    b. Trouble shooting abnormal engine operation
        (1) difficult starting
        (2) overheating
        (3) backfiring or explosion in the carburetor
        (4) missing at high speed
        (5) missing under slow hard pull
        (6) knocking
        (7) operating irratically
        (8) engine will not idle
        (9) excessive smoke from exhaust
        (10) loss of power

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. With several small engines prepared with ignition problems, have students diagnose and correct the problems.
2. Using engines that have been in use for a season, have students prepare the engines for off-season storage.
3. Students determine the possibility (economic and practical) of overhauling several types and makes of old small engines.
4. Students disassemble, inspect, and reassemble engines following procedures in the appropriate service manual.

D. COMPETENCIES

1. Repairing the small gasoline engine
   - Read the name plate information
   - Remove the shroud covering
   - Remove the flywheel
   - Identify defects in the electrical system
   - Replace faulty ignition system components
   - Remove, repair, replace and adjust carburetors
   - Disassemble and reassemble 2 and 4 stroke cycle engines
   - Replace cylinder head gaskets
   - Torque spark plugs correctly
   - Adjust valves
   - Test compression
   - Analyze engine performance
   - Select correct replacement parts
   - Use small engine tools correctly
   - Identify parts in parts catalogues
   - Repair wind up starters
   - Repair rewind starters
   - Repair electric starters
   - Remove, replace and/or adjust governors

2. Reconditioning and overhauling the small gasoline engine
   - Read name plate information
   - Disassemble and reassemble 2 and 4 cycle engines
   - Test compression
   - Analyze engine performance
   - Use small engine tools correctly
   - Adjust valves
   - Clean and gap spark plugs
   - Remove and replace valves
   - Identify faulty valves
   - Clean and grind valves
   - Test valve springs
   - Measure components and identify parts with excessive wear
   - Check cylinder head for warpage
   - Straighten crankshafts
   - Prepare a small gasoline engine for storage
   - Remove pully from crankshaft
   - Measure wear, remove and replace bearings
   - Remove and replace crankshaft
   - Check crankshaft end play
   - Measure cylinder wear and hone cylinder

Follow service manual in overhauling, reconditioning and repairing small gasoline engine
Remove, replace and grind valve seats
Replace valve guides

E. INSTRUCTIONAL MATERIALS

1. Small engines
2. Cutaway models of two-stroke and four-stroke cycle engines
3. Examples of worn parts that may be found in the engine
4. Operator's manuals
5. Tools used to overhaul small engines
6. Two stroke and 4 stroke cycle transparencies - 3M Company

F. SUPPORTING REFERENCES

1. *Small Gasoline Engines—Operation & Maintenance,* Ref. No. 40.
2. *Briggs & Stratton Repair Instruction IV,* Ref. No. 14.
3. *Small Engines.* (Volumes I & II), Ref. No. 3.
4. *Small Engines Service Manual,* Ref. No. 47.

## VI. TRACTOR OPERATION, MAINTENANCE, AND ENGINE ANALYSIS

UNIT CONCEPT: Safe operation of tractors and machinery is essential to the success and well-being of the agriculturalist. It is important also that correct maintenance of equipment be carried out to keep machines operating efficiently with a minimum of work stoppages because of breakdowns.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

Provided a farm tractor and the operator's manual of the tractor, the student will be able to:

1. determine correct maintenance procedures recommended for efficient operation of the tractor;
2. perform the tasks necessary for correct maintenance and safe operation of the tractor;
3. operate safely and efficiently the tractor and equipment which may be attached to it.

B. INSTRUCTIONAL AREAS

1. Developing a "Safety Attitude"

a. Costs of accidents
b. People, machine and environment, factors of accidents
c. Characteristics of a safe worker
d. Operator activity precautions
e. Why accidents occur

2. Understanding farm tractor instruments and controls
   a. Using the operator's manual
   b. The tractor instrument panel
   c. Tractor control systems
   d. Universal symbols for operator controls on agricultural equipment
3. Practicing maintenance and safety checks of the farm tractor
   a. The maintenance chart and periodic maintenance schedule
   b. Maintenance procedures
      1. Air cleaner
      2. Battery—electrical system
      3. Fuel system
      4. Lubrication systems
      5. Hydraulic systems
      6. Cooling system
      7. Tires
   c. The safety check
4. Operation of the farm tractor
   a. Starting the tractor engine
   b. Engine warm-up procedures
   c. Stopping the tractor engine
   d. Safety equipment
   e. Tractor stability
5. Tractor safety on the farm and the highway
   a. People-made hazards to tractor operation
   b. Natural-hazards to tractor operation
   c. Hitches
   d. Power-take-off
   e. Hydraulics
   f. Tractor safety on the road
   g. Virginia vehicle laws related to tractor operation and American Society of Agricultural Engineers/Society of Automotive Engineers Standards
6. Tractor and machinery accident situations
   a. Identifying accident situations by type of machine
7. Tractor safety standards
   a. Agencies developing design standards

b. Purpose of the standards
c. Definitions related to design standards
d. Service of tractors and machinery
e. Operator controls
f. Power-take-off
g. Shields and guards
h. Tractor protection roll over (ROPS)
i. Lifted units
j. Highway travel
k. Parking
l. Fire protection
m. Safety signs

8. Engine analysis
   a. Caring for, maintaining and operating test equipment
      1. Use of equipment
      2. Care and storage of test equipment
   b. Engine troubleshooting
      Troubleshooting procedures
      1. Engine systems
      2. Engine inspection
      3. Engine operation to determine malfunction
      4. Identifying problems
      5. Listing probable causes of engine malfunction
      6. Reach conclusion of causes of malfunction
      7. Test conclusion
      8. Replace faulty equipment

## C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Measure student reaction time
2. Identify tractor instruments and controls
3. Demonstrate correct seat adjustment
4. Complete a tractor maintenance check using an operator's manual as a guide
5. Complete a tractor safety check
6. Prepare an essay on the "safety attitude"
7. Demonstrate use of hand signals
8. Demonstrate factors of tractor stability using a toy tractor
9. Demonstrate uses of an operator's manual
10. Observe engine parts
11. Hold a tire inflation judging contest
12. Demonstrate ability to attach correctly battery jumper cables
13. Demonstrate the function of a thermostat

14. Observe types of fire extinguishers and demonstrate the ability to correctly use them
15. Prepare a list of first aid kit items for tractor use
16. Demonstrate the ability to operate correctly a tractor
17. Demonstrate the ability to hitch correctly a tractor to equipment
18. Demonstrate how the steering wheel of a tractor (or other vehicle) is turned when one looks to the rear
19. Visit a highway safety education officer for highway safety instruction
20. Demonstrate proficiency in driving a tractor and attached implement through a driving course
21. Survey a farm for accident hazards
22. Survey the community for blind corners
23. An examination on tractor safety and maintenance

D. COMPETENCIES

1. Operating a tractor or self-propelled machine
   Identify safety rules and regulations
   Locate, know function of and use tractor instruments and controls
   Perform safety checks on a farm tractor
   Start the tractor engine
   Stop the tractor engine
   Identify laws related to tractor operation
2. Connecting and disconnecting implements to tractor
   Connect and disconnect hitches
   Connect and disconnect power take-off
   Connect and disconnect hydraulic cylinder
3. Maintaining tractors
   Service air cleaners
   Service electrical system
   Service fuel system
   Service hydraulic system
   Service cooling system
   Service tires

E. INSTRUCTIONAL MATERIALS

1. Tractors
2. Types of air filter elements
3. Engine parts damaged due to abrasives in an engine
4. Hydrometer
5. Tire tester

6. Jumper cables
7. Fire extinguisher
8. Personal protective equipment
9. 3-point hitch implement
10. Two-wheel and four-wheel implement or trailer
11. Remote hydraulic cylinder
12. Materials for tractor driving course

F. SUPPORTING REFERENCES

1. *Safe Operation of Agricultural Equipment, Student Manual,* Ref. No. 94.
2. *Safe Operation of Agricultural Equipment, Instructor's Manual,* Ref. No. 93.
3. *Agricultural Machinery Safety,* Ref. No. 52.
4. *Accident Facts,* Ref. No. 73.
5. Tractor and machinery operator's manuals.
6. Newspaper accident reports.
7. *Tractor Maintenance Principles and Procedures,* Ref. No. 38.
8. *Farm and Ranch Safety Guide,* Ref. No. 74.
9. Instructors Kits
   a. *Agricultural Machinery Safety,* John Deere Service Publication, Ref. No. 52.
   b. IH farm equipment safety
      International Harvester Company
      Education Department
      401 N. Michigan Avenue
      Chicago, Ill.

## VII. EQUIPMENT SET-UP, ADJUSTMENT, OPERATION, AND MAINTENANCE

UNIT CONCEPT: The proper assembly, adjustment and service of equipment before or after delivery of the equipment to the customer will not only aid in efficient operation of such equipment, but will aid in developing and maintaining good customer-dealer relations.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

1. Provided unassembled equipment shipping bundles, inspect the bundles for missing parts and assemble the various types of

equipment according to directions in the operator's instructional manual.

2. Provided various types of assembled equipment, make initial adjustments on the equipment and provided pre-delivery service according to the directions in the operator's instructional manual.
3. Provided various types of malfunctioning equipment in need of minor repairs or service, make such minor repairs and service according to directions detailed in the operator's instructional manual.

B. INSTRUCTIONAL AREAS

1. Types of equipment used in agriculture
   a. Operation of various types of equipment such as:
      1. Mowers
      2. Rakes
      3. Balers
      4. Forage Choppers
      5. Combines
      6. Corn Pickers
      7. Cotton Pickers
      8. Potato Diggers
      9. Hay Conditioners
      10. Windrowers
      11. Fruit Pickers
      12. Plows
      13. Discs
      14. Drills
      15. Seeders
      16. Planters
      17. Sprayers
   b. Function of various components of the different types of equipment
2. Assembling various types of equipment
   a. Locate assembly instructions and read
   b. Checking the assembly instructions for any special procedures or tools that may be needed
   c. Locating the bundles, laying out the bundles where they will be convenient, and opening the bundles
   d. Checking the packing list against the parts in the bundles
   e. Separating the hardware items into convenient piles for identification
   f. Following instructions in assembling the various types of equipment: Example, side delivery rake
      1. Attaching the sub-frame to the basket frame
      2. Assembling the axle, wheels, arch, and jack assembly
      3. Installing the rear brace and idle sheave assembly
      4. Attaching the tilt bracket, front and diagonal brace and lift assembly
      5. Installing the lift crank

6. Attaching the basket to the main frame
7. Installing the right and left lift rods
8. Installing the belt on the sheaves
9. Installing the idler and belt shield
10. Installing the teeth on the one bar shipped without teeth
11. Installing optional equipment such as a remote clutch control, hydraulic cylinder control, dual wheels, and gauge wheel
12. Checking all bolts for correct torque and tighten any bolts that are too loose

3. Pre-delivery Servicing of Various Types of Equipment: Example, Side Delivery Rake
   a. Checking all pressure fittings when the rake is assembled and replacing any damaged fittings
   b. Lubricating the side delivery rake and cleaning any clogged fittings
   c. Testing the operation of the rake for smooth operation and proper alignment
   d. Making changes and adjustments if needed to provide smooth operation
   e. Making initial adjustments on the side delivery rake
      1. Adjusting the clutch clearance space to the manufacturer's specifications
      2. Initial leveling of the basket by adjusting the lift rods
      3. Initial adjustment for fluffy or loose windrows
      4. Initial friction brake adjustment for excessive bounce
      5. Initial adjustment of drive belt to the specification of the manufacturer
4. Delivering Equipment to the Customer: Example, side delivery rake
   a. Loading the side delivery rake on the truck or trailer or attaching the rake to a truck for delivery
   b. Chaining the rake when loaded on the truck to eliminate damage because of shifting while traveling
   c. Unloading the side delivery rake
   d. Giving the customer instructions on the operation and maintenance of the side delivery rake
      1. Explaining the use of the operator's manual
      2. Explaining general operation procedures for the side delivery rake
      3. Explaining general maintenance procedures for the side delivery rake (Maintenance schedule)
      4. Explaining how to make various adjustments on the side delivery rake

5. Filing the delivery report

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Have the students load machinery on a truck for delivery. The students should secure it by using chains and binders
2. Have students assemble various types of farm machinery
3. Have student role-play customer instruction of the machine upon delivery

D. COMPETENCIES

1. Setting up equipment
   - Read assembly instructions
   - Lay out bundles
   - Check packing list
   - Assemble the parts of the machine
2. Adjusting and testing farm equipment
   - Adjust equipment according to specifications given in the operator's manual
   - Test run machine to determine if it performs properly
3. Performing pre-delivery service
   - Check pressure lines and fittings
   - Lubricate machines
   - Test operate machine
   - Put all safety guards and instructions in place
4. Delivering farm equipment
   - Load and bind equipment
   - Unload equipment
   - Instruct customer on proper operation and maintenance

E. INSTRUCTIONAL MATERIALS

1. Unassembled equipment on which student will work
2. Service manuals and operator's manuals for the students to use
3. Appropriate hand tools such as pliers, screwdrivers, hammers, wrenches, socket sets, blocking, chains, binders, and hoists

F. SUPPORTING REFERENCES

1. *Agricultural Mechanics—Equipment*, Ref. No. 99.
2. *Machines for Power Farming*, Ref. No. 97.
3. Service manuals and assembly manuals for the equipment being worked on.

## AGRICULTURAL MACHINERY SERVICE IV

| *Major Learning Areas* | *Time Estimate Hrs.* |
|---|---|
| I. Orientation | 10 |
| II. Supervised Occupational Experience Programs | 20 |
| III. Leadership Training and/or FFA Activities | 40 |
| IV. Organization and Management of Agricultural Machinery Dealerships | 20 |
| V. Human Relations and Sales Techniques | 30 |
| VI. Fundamentals of Multicylinder Engines | 50 |
| VII. Using Service Manuals and Communication Equipment | 20 |
| VIII. Engine Analysis, Troubleshooting and Tune-Up | 70 |
| IX. Equipment Reconditioning and Repair | 80 |
| X. Evaluation/Testing | 20 |
| | 360 |

## I. ORIENTATION

UNIT CONCEPT: Proper organization of students and shop jobs in relation to safety, billing, inventory, housekeeping, etc., will provide a meaningful experience to students enrolled in agricultural machinery service programs.

### A. STUDENT PERFORMANCE OBJECTIVE

To establish from the beginning of school the expected behavior of students in relation to various shop procedures and policies.

### B. INSTRUCTIONAL AREAS

1. General Safety
2. Inventory Control
3. Housekeeping
4. Department Policies
5. Student Group Assignments
6. Locker, Tool, and Coverall Assignments
7. Job Billing Procedures
8. Specific Equipment Operation Procedures
9. Review 3rd Year

### C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Have students take tests on various areas of safety
2. Have students take tests on operation of equipment
3. Have students inventory tools for which they will be responsible
4. Discuss various department policies and procedures

### D. COMPETENCIES

1. Practicing laboratory safety
   - Wear and use personal protective equipment
   - Identify safety rules and regulations established for power tools and equipment operation in the laboratory
   - Operate equipment safely
   - Store combustibles safely
   - Select and use fire extinguishers
   - Secure first aid assistance in case of accident
   - Interpret safety signs, symbols, and color codes
2. Maintaining inventory control
   - Order inventory items

Record inventory items
Receive and stock inventory items

3. Maintaining clean and orderly work area
   - Organize jobs to be completed
   - Store parts neatly
   - Store tools
   - Clean work area
4. Following departmental policies
   - Participate in group assignments
   - Use job billing procedures

E. INSTRUCTIONAL MATERIALS

F. SUPPORTING REFERENCES

## II. SUPERVISED OCCUPATIONAL EXPERIENCE PROGRAMS

UNIT CONCEPT: The occupational experience program provides each student the opportunity to apply what has been learned in the classroom and laboratory. Given this system, all students should plan and conduct, under the supervision of their instructor, a program of application experiences commensurate with their instruction, personal interest and community resources. Experience gained in conducting an occupational experience program should lead to developing a saleable skill usable in the agricultural machinery and/or a related industry.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES:

The student should be able to:

1. Identify the tasks to be learned given a properly planned occupational experience program and employer.
2. Identify the FFA Proficiency Award(s) which would be applicable to the student's interest and occupational experience program.
3. Identify all the fringe benefits and their economic value to the employees of an agricultural machinery dealer of the student's choice.

B. INSTRUCTIONAL AREAS

1. Planning the Supervised Occupational Experience Program
   a. Writing occupational experience program agreements
   b. Keeping records of occupational experience activities
2. Summarizing and Evaluating Occupational Experience Program Records
3. Applying for FFA Awards
   a. Selecting appropriate awards for which to apply
   b. Understanding types of information asked for on the application
   c. Summarizing and transferring records from record book
   d. Filling out the application—securing proper signatures
   e. Submitting applications for competition
4. Understanding employee benefits and salary deductions
   a. Employee benefits
      1. Worker's Compensation
      2. Insurance
         a. Health
         b. Life
         c. Disability
         d. Personal liability
      3. Social Security
      4. Retirement
      5. Service Schools
      6. Vacations and Holidays
   b. Salary Deductions
      1. Federal Withholding Tax
      2. State Withholding Tax
      3. FICA (Social Security)

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Have each student write an occupational experience program agreement acceptable to the teacher and secure signatures of all persons with whom the agreement is made.

D. COMPETENCY

1. Securing occupational experience
   Plan a supervised occupational experience program
   Complete a supervised occupational experience program
   Record and analyze occupational experience program records
   Apply for proficiency awards

Identify employee benefits
Explain salary deductions

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. Record books, proficiency award forms

F. SUPPORTING REFERENCES

1. *FFA Advisor's Handbook*, Ref. No. 73.
2. *Human Relations in Agricultural Occupations*, Ref. No. 81.
3. *Resource Unit on Human Relations*, Ref. No. 88.
4. State and Federal Income Tax Guidelines.

## III. LEADERSHIP TRAINING AND/OR FFA ACTIVITIES

UNIT CONCEPT: Active participation in the FFA will provide the student opportunities for developing practical training in agriculture, leadership, cooperation, and citzenship.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

The student should be able to:

1. develop a strong self-concept and a positive attitude toward working in society as evidenced by public and private activities.
2. serve as an effective chairperson of a standing FFA committee.
3. participate effectively in a chapter parliamentary procedure demonstration.

B. INSTRUCTIONAL AREAS

1. Determining the place of FFA in Agricultural Machinery Service education
   a. Values of FFA membership
   b. Contibutions of FFA to the school and community
2. Participating in chapter activities and contests
3. Applying for FFA Proficiency Awards
   a. Selecting appropriate proficiency awards for which to apply
   b. Explaining types of information asked for in applications
   c. Summarizing and transferring records from record book
   d. Filling out the application form
4. Conducting Meetings
   a. Understanding people
   b. Kinds of meetings and when to use them

c. Panel discussions
d. Problem solving with groups
e. Using resource people
f. Using parliamentary procedure

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Students demonstrate skill proficiencies by participating in appliable FFA contests.
2. Students assist in planning the FFA program of activities.
3. Students become involved in community service by identifying, organizing and carrying out a needed civic project.

D. COMPETENCIES

1. Developing personal leadership characteristics
   - Best on recognition to others
   - Accept others as they are
   - Influence others
   - Persuade others
   - Speak effectively to others
   - Interact effectively with others
   - Listen effectively to others
   - Identify kinds of meetings and when to use them
   - Conduct panel discussions
   - Employ the problem-solving technique with groups
   - Utilize resource people
   - Demonstrate correct use of parliamentary procedure
   - Cooperate with others
2. Developing citizenship characteristics acceptable to society
   - Formulate a positive self-concept
   - Identify the values of youth organization membership
   - Identify the contributions of FFA to the school and community
   - Participate in chapter activities
   - Apply for FFA incentive awards

E. INSTRUCTIONAL MATERIALS

F. SUPPORTING REFERENCES

1. *Roberts' Rules of Order*, Ref. No. 90.
2. *Official FFA Manual*, Ref. No. 28.
3. *Virginia FFA Activity Handbook*, Ref. No. 39.

## IV. ORGANIZATION AND MANAGEMENT OF AGRICULTURAL MACHINERY DEALERSHIPS

UNIT CONCEPT: The person who is aware of the operating procedures in the parts, service, and equipment sales departments of an agricultural machinery dealership will be able to serve the customers in a effective and efficient manner.

### A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

1. Considering a specific agricultural equipment dealership, describe the organization of personnel in the departments and the role of each person in a department.
2. Given instructions outlined on a shop service order ticket and a maintenance or repair job, follow the instructions on the ticket to complete the job and fill in the time portion of the ticket.
3. Given a verbal description or shop order ticket and a parts catalog and price list, the student will write an order for parts with complete accuracy.

### B. INSTRUCTIONAL AREAS

1. Identifying the organizational pattern of agricultural equipment dealerships.
   A. Determining the purposes and functions of the departments
      1. Equipment Sales Department
      2. Parts Department
      3. Service Department
      4. Credit Department
   B. Determining the responsibilities of departmental personnel
   C. Following general business procedures
      1. Forms used by a dealership required by the government for such things as taxes, social security payments, workmans compensation, etc.
      2. Forms used by a dealership for the manufacturer
      3. Forms used by the business for recording personnel time and computing wages
2. Identifying procedures and practices used in the parts department
   A. Using parts catalogs and price lists
      1. Indexing parts catalogs and price lists
      2. Identifying appropriate parts from a customer's verbal description

3. Identifying appropriate parts from the shop service order ticket
4. Determining prices of parts

B. Controlling the parts inventory
1. Preparing and maintaining inventory records
2. Calculating inventory turnover
3. Using inventory recorder systems

C. Ordering parts
1. Identifying the various types of order forms
2. Filling in the order forms
3. Transporting and shipping parts
4. Receiving, binning, and/or storing parts

3. Following procedures and practices used in the service department
A. Using the shop service order ticket
1. Interpreting the job to be done from the shop service order
2. Using the parts listed on the shop service order and requesting additional parts needed

B. Filling in the labor repair time record on the shop service order ticket

C. Referring repair jobs to other individuals or specialists

4. Following procedures used in the equipment sales department
A. Determining what the market is and who the customers are
B. Computing price and selling margins
C. Appraising used machinery and equipment
D. Selling new machinery

## C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Tour a local agricultural equipment dealership which emphasizes selling modern equipment, selling a complete line of parts, and the repair of tractors and equipment.
2. Using the parts catalog and price list and given verbal information in a role-playing situation, correctly prepare the customer's order for parts.
3. While working on equipment in the school laboratory, have students prepare a shop service order ticket.

## D. COMPETENCIES

1. Organizing the agricultural machinery dealership

Establish the operating procedures and policies for the sales department
Establish the operating procedures and policies for the parts department
Establish the operating procedures and policies for the service department
Establish the operating procedures and policies for the business department
Establish job description(s) and personnel policies for the business

2. Managing the agricultural machinery dealership
   Identify the general business operating procedures for the dealership
   Use parts catalogs and price lists
   Use paper and computer billing procedures
   Use paper and computer ordering procedures
   Determine inventory turnover
   Keep inventory records
   Interpret the service order
   Schedule service activities and mechanic assignments
   Complete the service order when the job is finished
   Computer price and selling margins
   Appaise used equipment
   Advertise and promote equipment sales
   Identify potential market and customers

## E. INSTRUCTIONAL MATERIALS

## F. SUPPORTING REFERENCES


1. *Robert's Rules of Order,* Ref. No. 89.
2. *Official FFA Manual,* Ref. No. 28.
3. *Virginia FFA Activity Handbook,* Ref. No. 39
4. *Business Practices for Agricultural Dealers: Equipment Sales, Part 3,* Ref. No. 78.
5. *Business Practices for Agricultural Dealers: Parts Department, Part 2,* Ref. No. 78.
6. *Business Practices for Agricultural Dealers: Shop Service, Part 2,* Ref. No. 79.
7. *Business Practices for Agricultural Dealers: Teacher's Guide,* Ref. No. 80.

## V. HUMAN RELATIONS AND SALES TECHNIQUES

UNIT CONCEPT: It is important that an employee or self-employed person be aware of and learn to use the elements of good human relations and sales to be successful as one who operates or assists in operating an agricultural machinery or related business.

### A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

1. Identify with at least eighty percent accuracy the reasons why people fail on the job.
2. Given a simulated classroom situations, correctly demonstrate how to take messages on the telephone.
3. Given a simulated classroom situation correctly demonstrate how to close a sale.

### B. INSTRUCTIONAL AREAS

1. Human Relations in the Agricultural Equipment and Mechanics Business
   - A. Determining why people fail and succeed on the job
     - 1) Identifying common causes of failure
     - 2) Identifying human needs and motives that are satisfied by occupations
     - 3) Recognizing how human motives and needs affect human relations
   - B. Identifying human relations situations in the Agricultural Equipment and Mechanics Business
     - 1) Assessing the employee's role
     - 2) Assessing the employer's role
     - 3) Assessing the supervisor's role
     - 4) Assessing the customer's role
   - C. Considering factors that influence the human relations process in Agricultural Equipment and Mechanics
     - 1) Assessing the influence of personality in human relations
     - 2) Relating to your fellow employees
     - 3) Relating to your supervisors
     - 4) Relating to the firm's customers
   - D. Communicating with customers and personnel in the business
     - 1) Using the telephone effectively
       - a. Making telephone calls

b. Answering the telephone
c. Taking messages

2) Communicating through written media
a. Writing letters
b. Responding to letters
c. Writing instructions

3) Communicating Through Body Language

4) Succeeding on the Job
a) Obtaining a job
b) Personality development
c) Relating with workers
d) Relating with management
e) Inservice training

2. Agricultural Equipment and Mechanics Sales Techniques
a. Determining the duties and responsibilities of sales personnel in agricultural equipment and mechanics
1) Selling duties and responsibilities
2) Non-selling duties and responsibilities

b. Assessing the attributes of successful sales personnel
1) Influence of personality
2) Influence of mental attitude
3) Importance of physical appearance
4) Importance of product knowledge

c. Advertising and displaying items for sale
1) Preparing announcements for news media
2) Preparing displays for selling

d. Approaching and meeting the potential customer
1) Greeting the customer
2) Handling different kinds of customers

e. Securing customer attention and interest
1) Developing interest
2) Maintaining interest

f. Handling customer objections
1) Identifying objections (price, false ideas about the product, time, source, etc.)
2) Developing ability to handle objections and still keep customer attention
3) Selling substitute items

g. Closing the sale
1) When to close the sale
2) Identifying different techniques for closing sale

3) Recording sale and completing the appropriate forms
4) Making change and using the cash register
5) Following up the sale

h. Handling customer complaints after the sale has been completed
1) Identifying complaint and determining its source
2) Following appropriate procedures for handling the complaint

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Have students role play making a sale.
2. Have each student in the class observe an experienced salesperson handling a customer complaint and make a written report on how the complaint was handled, whether or not it was handled correctly and how it could have been improved.
3. By using a cash register in the classroom, have each student perfom the task of closing a sale and making correct change.

D. COMPETENCIES

1. Succeeding on the job
Identify the common causes of job failure
Identify human needs that are satisfied by occupations
Recognize the reasons why people are satisfied with their occupation
Determine how human motives and needs affect human relations
Identify the desirable characteristics of an employee
Recognize the role of the employee, employer, supervisor and customer
Use the telephone correctly
Communicate effectively through written media
Communicate effectively through body language
Obtain a job
2. Selling agricultural equipment, parts and service
Identify the duties of a salesperson
Identify the desirable attributes of sales personnel
Prepare sales displays
Prepare advertisements
Meet a customer effectively
Secure customer attention and interest
Handle customer objections
Close a sale

E. INSTRUCTIONAL MATERIALS

1. Record books, proficiency award forms, cash register with adequate amount of play money

F. SUPPORTING REFERENCES

1. *Advertising and Promotion*, Ref. No. 75.
2. *Agricultural Salesmanship*, Ref. No. 76.
3. *FFA Advisor's Handbook*, Ref. No. 25.
4. *Improving Communications-Leadership and Personal Development, Series No. 5*, Ref. No. 34.
5. *Human Relations in Agricultural Occupations*. Ref. No. 81.
6. *Parts Purchasing Control Procedures*, Ref. No. 70.

## VI. FUNDAMENTALS OF MULTICYLINDER ENGINES

UNIT CONCEPT: Multicylinder engines are the primary source of power for machinery used on today's farms. Being able to properly maintain, repair and overhaul agricultural power units require workers to have a thorough working knowledge and understanding of fundamentals of engine operation.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

The student should be able to:

1. Recognize symptons that may be caused by defects in the starting circuit, the charging circuit, and/or the lighting and accessory circuits, diagnose the nature of the defects by following approved troubleshooting procedures detailed in the service manual.
2. When provided with equipment with defects or maladjustments in the charging circuit, remove, disassemble, test, inspect, replace, reassemble, and install, according to the procedure in the service manual, the following components of the charging circuit:
   a. Generator
   b. Voltage Regulator
   c. Alternator, if the engine is so equipped
3. When provided with an engine with mechanical malfunctions, diagnose the nature of the malfunctions following approved trouble-shooting procedures detailed in the service manual.

B. INSTRUCTIONAL AREAS

1. History and development of tractors and power units
   a. Early inventors and tractor development
   b. Engine types
2. Power and its Measurement
   a. Understanding power terms
   b. Understanding the relationship of horse power, speed and torque for engines
   c. Determining the correct horsepower size in selecting farm tractors
   d. Understanding the principles of dynamometer operation
   e. Measuring horsepower and interpreting the results
      1) Using power unit dynamometers
      2) Using power take-off dynamometers
3. Principles of Internal Combustion Engines
   a. Engine Cycles and Principles of Operation
      1) Diesel
      2) Gasoline
   b. Identification of parts of internal combustion engines
      1) Diesel-comparison with gasoline parts
      2) Gasoline - comparison with diesel parts
   c. Engine efficiency
   d. Bore and stroke ratio
   e. Compression ratio and displacement
4. Engine Construction and Design
   a. Materials of construction
   b. Crankshafts and firing orders
   c. Engine Balance
   d. Valve design, materials, timing and servicing
   e. Combustion chamber design
5. Fuels and Lubrication Systems
   a. Selecting fuel for gasoline engines
   b. Selecting fuel for diesel engines
   c. Providing storage facilities for gasoline
   d. Providing storage facilities for diesel fuel
   e. Selecting crankcase oil
   f. Selecting gear lubricant
   g. Selecting hydraulic fluid
   h. Selecting lubricating grease
   i. Operation of lubrication system
      1) Parts identification
      2) Types of systems

3) Oil filters and filtration systems
4) Oil coolers

j. Operation of fuel systems
1) Gasoline systems
a) Parts identification
b) Principles of operation
c) Types of carburetors
d) Adjusting the gasoline carburetor
2) Diesel systems
a) Parts identification
b) Principles of operation
c) Types of injection pumps
d) Fuel filters
e) Importance of service

6. Engine Governor System
a. Purpose of Governors
b. Importance of Governor Adjustment
c. Principles of Operation
1) Gasoline Engines
2) Diesel Engines

7. Tractor Electrical Systems
a. Fundamentals of Electricity
b. Storage Batteries
c. Cranking Circuit
d. Ignition Circuit
1) Primary Circuit - Gasoline Engines
2) Secondary Circuit - Gasoline Engines
3) Heat of compression - Diesel Engines
e. Charging Circuit
f. Accessory Circuit

8. Engine Intake Systems
a. Types of Air Cleaners and how they work
b. Importance of air cleaner service
c. Carburetors
d. Intake manifolds
e. Turbo-chargers

9. Engine Cooling Systems
a. Operation of cooling systems
b. Selecting coolants

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Have students observe symptons in an engine which has mal-adjustments or defects in the starting circuit, cranking circuit, and lighting circuit. Aftr the symptons have been listed, have students refer to a service manual to identify possible defects that may be contributing to the appearance of the symptons.
2. Using the engines on which the students are working, have the students remove and replace electrical fuses being sure that the replacements are of the proper size.
3. Using the engines on which the students are working, have the students check the coil with a test lamp and probes for grounded windings.
4. Have the students remove the distributor cap from the engines they are working on and inspect the condition of the cap and rotor and check the breaker point gap.

D. COMPETENCIES

Maintaining, repairing and overhauling multicylinder engines
Discuss the meaning of horsepower and how it is measured
Identify the relationship of horsepower, speed and torque
Identify the principles of operation of the multicylinder engine
Recognize by name multicylinder engine parts
Discuss differences in multicylinder engine design and construction
Identify lubrication system parts and their functions
Discuss the fundamentals of electricity used in tractor electrical sytems
Identify the parts and their function in the following electrical circuits: cranking, ignition (primary and secondary), accessory and charging
Relate intake system component parts and their functions
Maintain the engine intake system
Identify cooling system parts and functions
Maintain the engine cooling system

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. Engines on which students will work
2. Examples of defective parts for the students to inspect and test
3. Appropriate small hand tools for the students to use such as: wrenches, screwdrivers, pliers, wire stripper and crimper, a straight-edge, ruler, and a spoon or riffler file to clean the regulator contact points.

4. Regulation—generator tester, ammeter, voltmeter, carbon pile resistor, and a test lamp and probes or other test equipment
5. Cloth, cleaning solvent and cleaning brushes
6. Charts of components of the ignition system
7. Special testing equipment for the ignition system such as a timing light, hydrometer, battery charger, volt meter, test lamp with probes and meter-type coil and condensor tester

F. SUPPORTING REFERENCES

1. *Farm Tractor Tune-Up*, Ref. No. 102.
2. *Fundamentals of Service: Electrical Systems*, Ref. No. 57.
3. Service manuals for the engine on which work is being performed.
4. *The Ignition Circuit and How it Works*, Ref. No. 31.
5. *The Ignitions System-Testing and Analyzing Test Results*, Ref. No. 104.
6. *Individual Study Guide on Electrical Systems for Spark—Ignition Engines*, Ref. No. 82.
7. *The Tractor Electrical System*, Ref. No. 4.
8. *The Gasoline Engine Electrical System*, Ref. No. 16.
9. *Farm Tractor Tune-Up and Service Specifications*, Ref. No. 101.

## VII. USING SERVICE MANUALS AND COMMUNICATION EQUIPMENT

UNIT CONCEPT: The employee who provides correct customer service is a valuable asset to an agricultural machinery dealership. The use of communications equipment can eliminate unnecessary road travel and increase the efficiency of service or sales-persons

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

1. Provided with equipment that needs to be repaired or serviced, locate the proper service manual to use for working on the equipment.
2. Using a service or assembly manual, determine the proper location or various parts and locate the proper adjustments to make on the various parts.
3. Provided a two-way (CB) radio, operate the equipment in accordance with Federal Communications Commission regulations and adjust for squelch and volume.

B. INSTRUCTIONAL AREAS

1. Reading and interpreting service and assembly manuals
   a. Determining the proper manual to use
      1) Locating model number on equipment
      2) Obtaining proper service manual from the files
      3) Determining why it is essential to use the correct service and assembly manuals
   b. Using the proper manual
      1) Understanding sketches in the manual
         a) Types of lines and what they mean
         b) Abbreviations and what they mean
      2) Locating specifications for making adjustments
         a) Specifications and tolerance for specificed parts
         b) Abbreviations used in specification parts
      3) Using service manuals to determine parts numbers
      4) Storing and caring for manuals
2. Using radio communications equipment
   a. Turning on the radio and making correct adjustments
   b. Transmitting and receiving messages
      1) Making contact using call letters
      2) Transmitting the message and signing off
   c. Observing Federal Communications Commission regulations
      1) Purpose of rules for radio
      2) Laws and regulations applying to the operation of communications equipment
      3) Licensing for operation

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Students use the correct service or assembly manual.
2. Students determine proper specifications or tolerance from the service or assembly manual.
3. Using two-way (CB) radios, have the students practice transmitting messages using call numbers to contact the home base.

D. COMPETENCIES

1. Using service manuals
   Select correct manual for use
   Secure identification number for equipment
   Identify types of lines used in manuals and what they mean
   Identify abbreviations in manuals and relate what they mean
   Read manual

Interpret manual
Store and care for manuals

2. Using communications equipment
   Hook up a two-way radio
   Turn on and adjust radio
   Transmit messages
   Receive messages
   Relate laws and regulations governing radio use

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. Service and assembly manuals
2. Two-way radios
3. Slides or photographs showing identification numbers on equipment

F. SUPPORTING REFERENCES

1. *I & T Shop Service Manuals,* Ref. No. 48.
2. *Rules and Regulations of the FCC, Volume VI,* Ref. No. 23.

## VIII. ENGINE ANALYSIS, TROUBLESHOOTING AND TUNEUP

UNIT CONCEPT: When an engine no longer operates efficiently and correctly, diagnosis of problems and tuneup or repair of the engine should be completed as quickly and economically as possible. A service worker follows a logical sequence in determining needed service, tuneup or repair of engines.

A. STUDENT PERFORMANCE OBJECTIVES

The student should be able to:

1. follow service manual procedures in making "visual and ear" inspections for engine component defects and malfunctions
2. diagnose engine troubles by following service manual procedures and using test equipment correctly.
3. analyze engine performance.

B. INSTRUCTIONAL AREAS

1. Caring for, maintaining and operating test equipment
   a. Use of equipment
   b. Care and storage of test equipment
      1. Engine troubleshooting

B. INSTRUCTIONAL AREAS

1. Caring for, maintaining and operating test equipment
   a. Use of equipment
   b. Care and storage of test equipment
2. Engine troubleshooting
   a. Troubleshooting procedures
      1) Engine systems
      2) Engine inspection
      3) Engine operation to determine malfunction
      4) Identifying problems
      5) Listing probable causes of engine malfunction
      6) Reach conclusion of causes of engine malfunction
      7) Test conclusion
      8) Replace faulty equipment
   b. Preliminary diagnosis using "visual and ear" inspection to identify symptons
      1) Engine will not start or is hard to start
         a) Checking the electrical starting system
         b) Checking for correct fuel
         c) Checking the compression
      2) Lack of power
         a) Checking the fuel system
         b) Checking for slippage in the traction clutch
         c) Checking the operation temperature of the engine
         d) Using vacuum gauge to make manifold depression test
         e) Checking the air intake and exhaust system
         f) Checking engine RPM with tachometer
         g) Checking compression
         h) Checking for misfiring
         i) Checking crankcase oil
      3) Smoke from exhaust system (especially on diesel engines)
         a) Checking operating temperature
         b) Checking fuel
         c) Checking the air intake and exhaust system
         d) Checking the combustion system and compression
         e) Checking the fuel injection system on diesel engine and the carburetor
         f) Checking the crankcase oil
      4) Excessive fuel consumption
         a) Checking the smoke from the exhaust
         b) Checking the fuel
         c) Checking for internal and external fuel leaks

5) Excessive oil consumption
   a) Checking the crankcase oil
   b) Checking exhaust smoke for color indicating oil consumption
   c) Checking the crankcase breather
   d) Checking for external leakage
6) Excessive engine noise, knock, and vibration
   a) Checking to see if the noise changes with change of RPM
   b) Checking for engine knock and vibration under "cold" and "hot" operating conditions

3. Analyzing engine performance
   a. Horsepower tests
   b. Distributor timing and dwell
   c. Cylinder leakage tests
   d. Vacuum pressure tests
   e. Engine idle tests
   f. Fuel efficiency tests
   g. Engine compression tests
   h. Diesel fuel injection tests

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Students visually inspect an engine for any symptons which may indicate problems with the internal combustion engine. The students should be looking for such defects as water leaks, oil leaks, or loose belts and frayed belts.
2. Students complete a manifold vaccum test on an engine.
3. Compare engine performance with manufacturer's specifications.

D. COMPETENCIES

1. Using and maintaining test equipment
   Read and interpret operating instructions
   Read test instrument scale correctly
   Hook-up test instrument correctly
   Adjust test instrument
   Replace batteries in test instrument
2. Troubleshooting and tuning engines
   Start and operate engine properly
   Perform visual inspection of engine components
   Test, analyze, and repair cranking circuit
   Test, analyze, and repair primary ignition circuit

Test, analyze, and repair secondary ignition circuit
Test, analyze, and repair accessory circuit
Test, analyze, and repair charging circuit
Troubleshoot and identify fuel problems
Adjust carburetors
Adjust valves

3. Analyze engine performance
   Check timing and dwell settings
   Check for cylinder leakage
   Conduct vaccum pressure test
   Conduct fuel injection test
   Perform horsepower test
   Conduct engine idle test

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. Engines on which the students will work.
2. Specialized test equipment such as timing lights, vaccum gauge, dynamometer, compression gauge, thermostat testing instrument, hydrometer, meters for checking the electrical system, oscilloscope, combustion analyzer, and tachometer.
3. Appropriate small hand tools such as wrenches, pliers, screwdrivers, and socket set.
4. Troubleshooting charts.
5. Service manuals.

F. SUPPORTING REFERENCES

1. *Fundamentals of Service: Engines,* Ref. No. 58.
2. Service manuals for the engines under repair.
3. *Farm Tractor Tune-Up and Service Specifications,* Ref. No. 103.
4. *The Gasoline Engine Electrical System,* Ref. No. 16.

## IX. EQUIPMENT RECONDITIONING AND REPAIR

UNIT CONCEPT: When farm equipment is broken, worn or inoperative, it is economically important to get it repaired and/or reconditioned so it can be put back in service as quickly as possible. A worker must be able to do several tasks in order to recondition and repair farm equipment satisfactorily.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

The student should be able to:

1. Set up welding equipment, make desired adjustments safely

and operate the welders in any reasonable performance job.
2. Completely clean the equipment using either air, chemicals, and/or steam by following the directions in the operator's manual for the steam cleaner or other equipment, when provided equipment to be reconditioned.
3. Complete a paint job when provided machinery ready for painting and spray painting equipment.

B. INSTRUCTIONAL AREAS

1. Equipment Reconditioning
   a. Identifying symptons of problems in machine operation
   b. Inspecting and identifying worn or faulty machine components
   c. Ordering machine componenets to be replaced
   d. Removing or repair of faulty parts
   e. Reconditioning and/or replacing faulty parts
   f. Adjusting machine components according to service manual specifications
   g. Field test the machine after reconditioning
2. Arc Welding
   a. Understanding the arc welding process including:
      1) Hazards
      2) Protective devices
      3) Types of welding machines
      4) Current control care and precautions
      5) Electrodes as A.W.S. classification numbers
      6) Polarity
   b. Fundamentals of Out-of-Position Arc Welding
      1) Current setting
      2) Arc length
      3) Rate of travel
      4) Angle of electrodes
   c. Performing welding exercises
      1) Starting the arc and running the vertical, and/or overhead beads
      2) Welding vertically downward and upward
      3) Running beads with work position for horizontal welding
      4) Making a fillet weld on the inclined plane
      5) Welding different metals in different positions as:
         a) Cast iron—horizontal and vertical positions
         b) Brazing steel in horizontal and vertical positions
         c) Building a pad-horizontal and vertical positions

6) Cutting steel and cast iron-metal arc process
7) Uses of the carbon arc attachment
8) Welding carbon steels
9) Hardsurfacing with the arc

3. Gas Welding
   a. Safety in
      1) Handling and storing oxygen and acetylene
         a) Caution to be observed when handling oxygen cylinders and acetylene cylinders
      2) Safety equipment necessary for skin and sight protection
   b. Fundamentals of out-of-position welds with oxyacetylene gas
      1) Welding open corner butt welds
      2) Making a fillet weld
      3) Welding with materials placed in-other-than flat position
         a) Vertical weld
         b) Vertical weld or inclined plane
         c) Backhand method of making vertical weld
         d) Horizontal weld on vertical surface
         e) Overhead welding
         f) Backhand method of making overhead weld
         g) Hardfacing and pad building
      4) Welding different metals with the oxyacetylene outift
         a) Alumninum
         b) Cast iron
         c) Carbon steels
         d) Pipe-iron and mild steel
      5) Cutting metal with an oxyacetylene flame
         a) Mild steel
         b) Cast iron
   c. Fundamentals of welding with Mig & Tig welders
      1) Welding processes using inert gases
         a) Argon
         b) Helium
         c) Carbon dioxide
         d) Mixtures
      2) Advantages of inert gas welding
      3) Welding equipment and power supply
      4) Safety factors
4. Spray Painting
   a. Selecting the Proper Equipment
      1) Compressor

2) Air Regulators, Hose and Water Traps
3) Spray Guns
4) Sanders and Grinders
5) Spray Booths, Exhaust, and Lighting Equipment

b. Cleaning Agricultural Equipment
1) Precautions and procedures in using chemicals for cleaning various components of agricultural equipment
2) Procedures and precautions to follow in using steam for cleaning agricultural equipment
3) Practices to follow in using air to clean agricultural equipment

c. Preparing Cleaned Agricultural Equipment for Applying Primer
1) Removing dents and straightening metal
2) Replacing defective or broken parts
3) Sanding and featheredging the equipment for the primer coat
4) Masking the equipment or using other methods to prepare for applying the primer coat

d. Operating Spray Painting Equipment
1) Mixing, thinning, and straightening metal
2) Safety precautions that should be observed in operation of the paint spraying equipment
3) Adjusting the spray painting gun
4) Factors to consider in using the spray painting gun that will influence a successful paint job
5) Cleaning the spray gun

e. Applying the Primer Coat on Agricultural Equipment
1) Selecting a primer paint
2) Applying the primer coat

f. Applying the Finish Coat
1) Selecting a finish paint
2) Applying the finish coat
3) Applying stencils and decals
4) Removing masking tape or other materials used in masking

g. Correcting a Poor Paint Application Job
1) Identifying "Defective" paint spots
2) Determining how to correct for defective paint jobs
3) "Rubbing Out" defective spots

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Apply welding processes in machinery reconditioning
2. Students working in groups of 3 or 4 use a commercial solvent and a steam cleaner to clean an agricultural machine and prepare it for painting. Have the students dissassemble and position parts for easiest method of sanding and painting.
3. Demonstrate the correct procedure for cleaning a spray gun.

D. COMPETENCIES

1. Reconditioning equipment
   - Identify symptons of problems in machine operation
   - Inspect and identify worn and faulty parts
   - Order replacement parts
   - Remove faulty part
   - Replace new or reconditioned part
   - Adjust component and/or machine
   - Field test machine
2. Repairing equipment using arc welding process
   - Relate safety to be observed in welding equipment
   - Wear personal protective equipment
   - Select type of welding machine for needed weld
   - Set amperage on welding machine
   - Select proper electrode
   - Set polarity
   - Perform welding task using the correct welding position (downhand, horizontal, vertical, or overhead)
3. Repairing equipment using oxyacetylene welding process
   - Relate safety to be observed when gas welding on equipment
   - Wear personal protective equipment
   - Select the welding position for the repair to be made
   - Select the type rod and flux for metal to be welded
   - Adjust the flame for the type weld to be made
   - Adjust flame for the type cut to be made
   - Turn on welding equipment
   - Adjust gas line pressure to recommended settings
   - Read recommended line pressure setting chart
   - Perform equipment repair using gas welding process
4. Welding equipment with Mig and Tig welders
   - Identify safety to be observed with Mig and Tig welders
   - Wear personal protective equipment
   - Select type of inert gas welder best suited to repair task

Turn on Mig or Tig welder
Adjust welding machine
Perform repair task
Turn off machine

5. Spray painting equipment
   Select proper spray painting equipment
   Turn on compressor
   Relate safety to be observed
   Select proper personal protective equipment
   Clean machinery for painting
   Remove dents, straighten, sand, and tape equipment to be painted
   Operate spray painting equipment
   Apply primer paint coat
   Apply finish paint coats(s)
   Correct defects in paint job
   Perform painting task

## E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

Arc welding supplies
Gas welding supplies
Inert gas welding supplies
Paint spraying supplies
Hand tools

1. Different types of agricultural equipment for the students to repair.
2. Complete unit of spray painting equipment and booth with ventilation system is desirable.
3. Air compressor, parts cleaning tank with commercial solvent, an steam cleaner.
4. Appropriate tools for removing parts of the equipment such as pliers, screwdrivers, wrenches, socket sets, hammers, and various sizes of body dollies.
5. Masking tape, paper, and grease for masking the equipment.
6. Sandpaper, emery cloth, strainers, and sanders.

## F. SUPPORTING REFERENCES

1. *Welding Processes,* Ref. No. 33.
2. *Agribusiness: Metal Working,* Ref. No. 8.
3. *Source Unit in Oxyacetylene Welding,* Ref. No. 9.
4. *Farm Mechanics Text and Handbook,* Ref. No. 87.
5. *Modern Farm Mechanics,* Ref. No. 110.

6. *Teacher's Manual: Arc Welding Instructions for the Beginner,* Ref. No. 50.
7. *The ABC's of Spray Equipment,* Ref. No. 21.
8. *Spray Painting,* Ref. No. 103.
9. *Working in Agricultural Mechanics,* Ref. No. 94.
10. *A Guide to Better Refinishing,* Ref. No. 69.

## AGRICULTURAL MACHINERY SERVICE V

| *Major Learning Areas* | *Time Estimate Hrs.* |
|---|---|
| I. Orientation | 10 |
| II. Supervised Occupational Experience Programs | 20 |
| III. Occupational Opportunities | 10 |
| IV. Leadership Training and/or FFA Activities | 30 |
| V. Basic Hydraulics | 40 |
| VI. Mechanical Power Transfer Systems | 30 |
| VII. Gasoline and Diesel Engine Overhaul | 180 |
| VIII. Electrical Applications for Agricultural Equipment | 20 |
| IX. Evaluation/Testing | 20 |
| | 360 |

## I. ORIENTATION

UNIT CONCEPT: Proper organization of students and shop jobs in relation to safety, billing, inventory, housekeeping, etc., will provide a more meaningful experience to students enrolled in agricultural machinery programs.

A. STUDENT PERFORMANCE OBJECTIVES

1. To establish at the beginning of the course, the expected behavior of students in relation to various shop procedures and policies.

B. INSTRUCTIONAL AREAS

1. Safety
2. Inventory Control
3. Housekeeping
4. Department policies
5. Student Group Assignments
6. Locker, Tool, and Coverall Assignments
7. Job Billing Procedures
8. Specific Equipment Operation Procedures
   a. Procedures
   b. Safety Testing
9. Course Objectives and Content
10. Course Evaluation Procedures

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Assign tools, etc. and have students responsible for them the entire school year.
2. Discuss various department policies and procedures
3. Demonstrate use of fire extinguisher

D. COMPENTENCIES

1. Practicing laboratory safety
   Wear and use personal protective equipment
   Identify safety rules and regulations established for power tools and equipment operation in the laboratory.
   Operate equipment safely
   Store combustibles safely

Select and use fire extinguishers
Secure first aid assistance in case of accident
Interpret safety signs, symbols and color codes

2. Maintaining inventory control
   Order inventory items
   Record inventory items
   Receive and stock inventory items
3. Maintaining clean and orderly work area
   Organize jobs to be completed
   Store parts neatly
   Store tools
   Clean work area
4. Following departmental policies
   Participate in group assignments
   Use job billing procedures

E. INSTRUCTIONAL MATERIAL

Handouts

F. SUPPORTING REFERENCES

## II. SUPERVISED OCCUPATIONAL EXPERIENCE PROGRAMS

UNIT CONCEPT: The occupational experience program provides each student the opportunity to apply what has been learned in the classroom and laboratory. Given this system, all students should plan and conduct, under the supervision of their instructor, a program of application experiences commensurate with their instruction, personal interest and community resources. Experience gained in conducting an occupational experience program should lead to developing a saleable skill usable in the agricultural machinery and/or a related industry.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

Student should be able to:

1. summarize and analyze his occupational experience records to the satisfaction of the teacher;
2. complete satisfactorily an FFA proficiency award application;

3. set up and satisfactorily conduct an employment interview and secure a job for his/her cooperative work experience program.

B. INSTRUCTIONAL AREAS

1. Planning the Supervised Occupational Experience Program
   a. Writing occupational experience program agreements
   b. Keeping records of occupational experience program activities
2. Summarizing and evaluating the student's occupational experience program records
3. Applying for FFA Awards
   a. Selecting appropriate awards for which to apply
   b. Understanding types of information asked for on the application
   c. Summarizing and transferring records from record book
   d. Filling out the application
   e. Submitting applications for competition
4. Applying and Interviewing for a Job
   a. Applying for a job
      1) Determining application letter content, form, length, salutation, etc.
      2) Preparing an application form
      3) Making an interview appointment by telephone.
   b. Conducting a job interview
      1) Personal appearance
      2) Mannerism
      3) Communicating with the Employer
   c. Conducting a follow-up interview
   d. Job acceptance

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Invite a personnel director to class to conduct a job interview with a student. At conclusion of interview, have director critique interview. Tape session for future use.
2. Using a simulated class setting, have each student schedule an interview appointment by telephone.

D. COMPETENCIES

1. Securing occupational experience
   Plan a supervised occupational experience program
   Record and analyze occupation experience program records
2. Secure employment

Apply for a job
Conduct a job interview
Accept a job

E. INSTRUCTIONAL MATERIALS

SOEP Record Books
Proficiency Award Applications
Employment Application Forms
Transparencies

F. SUPPORTING REFERENCES

1. *FFA Advisor's Handbook*, Ref. No. 25.
2. *Good Grooming—Leadership and Personal Development Series No. 2*, Ref. No. 35.
3. *How to Find and Apply for a Job*, Ref. No. 67.
4. *Experience Programs for Learning Vocations in Agriculture*, Ref. No. 13.
5. *How to Get a Job*, Ref. No. 24.

## III. OCCUPATIONAL OPPORTUNITIES

UNIT CONCEPT: At the conclusion of the Agricultural Machinery Service course, a student should have a saleable skill in this or a related area. Assisting students in locating, identifying and evaluating job opportunities are important considerations in securing employment for students who complete the program.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

1. Each student prepare a one hundred and fifty minimum word report on the job
   Machinery Service industry and the competencies needed to secure this job at the entry level.
2. Each student successfully identifies all local sources of job openings in Agricultural Machinery and/or related areas.

B. INSTRUCTIONAL AREAS

Occupational opportunities in agricultural equipment and mechanics

a. Assessing the job opportunities available in agricultural equipment and mechanics
   1) Locating information on the scope of the agricultural equipment
   2) Surveying the local region for entry level jobs regarding the number of openings per year and future employment needs
b. Making a detailed study of selected agricultural equipment and mechanics occupations
   1) Determining what personal interests are and how they relate to a specific job or cluster or occupations
   2) Assessing the competencies that are desirable for job entry
   3) Determining the educational requirements necessary for employment
   4) Assessing the personal traits required by the occupation
   5) Determining the worker benefits in a given occupation
   6) Considering federal and state regulations which apply to various occupations
c. Identifying vacant positions in which students are interested
   1) Agricultural Production and related areas
   2) Agribusiness and related areas

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Plan and conduct a career day for students of agriculture and invite area agricultural equipment dealers and members of Virginia Farm and Industrial Equipment Dealers Association.
2. Invite a representative of the Virginia Employment Commission to visit the class and discuss employment opportunities in agricultural mechanics.

D. COMPETENCY

1. Select a job
   Secure information on available job opportunities
   Evaluate personal qualification(s) for the job
   Identify worker benefits in a given job
   Determine federal and state regulations which apply to occupation(s) of student interest
   Identify opportunities for self-employment

E. INSTRUCTIONAL MATERIALS

Transparencies
Local Slides

F. SUPPORTING REFERENCES

1. Agricultural Census Data
2. *Handbook of Agricultural Occupations*, Ref. No. 42.
3. *There's A Future Here, Will You Be In It*, Ref. No. 46.
4. *Exploring Agribusiness*, Ref. No. 91.

## IV. LEADERSHIP TRAINING AND/OR FFA ACTIVITIES

UNIT CONCEPT: Active participation in FFA will provide students opportunities for developing practical training in agriculture leadership, cooperation and citizenship.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

The student should be able to:

1. Effectively participate in a local agricultural mechanics and/or tractor trouble shooting contest.
2. Properly fill out and submit application for the State Farmer degree.
3. Effectively serve as an FFA officer.

B. INSTRUCTIONAL AREAS

1. Encouraging FFA membership
   a. FFA members assist in orientation of prospective students
   b. FFA members encourage continued participation by current enrollees
2. Participating in appropriate student incentive award programs and instructional contest
   a. Proficiency award
   b. State Farmer Degree
   c. Appropriate FFA contest
      1) Tractor Trouble Shooting
      2) Tractor Driving
      3) Parlimentary Procedure
      4) Public and Extemporaneous Speaking
      5) Other
3. Developing an understanding of and appreciation for the FFA Alumni
   a. History and development of FFA Alumni
   b. Purposes of FFA Alumni
   c. How to become a member and types of membership
   d. Alumni activities

1) FFA school activities
2) FFA community activities
   a) Church
   b) Service organizations

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Conduct a local tractor troubleshooting contest for chapter members.
2. Have each student submit application for the State Farmer Degree.
3. Serve as an FFA officer or standing committee chairperson.
4. Apply for FFA State Office.

D. COMPETENCIES

1. Securing leadership experience
   Prepare and deliver speech
   Conduct an effective meeting
   Use accepted parliamentary procedure
   Identify the duties and responsibilities of officers
   Write news articles
   Participate in radio and TV program(s)
2. Securing experience in cooperating with others
   Use resource people for FFA and class activities
   Prepare and display exhibits
   Participate in community activities
   Participate in committees
3. Developing citizenship skills
   Participate in community activities
   Use proper social manners
   Participate in contest
   Apply for incentive awards
   Establish FFA alumni organization
   Encourage student membership in FFA
   Use proper grooming manners

E. INSTRUCTIONAL MATERIALS

Transparencies
Chapter Scrapbook
Old Proficiency Applications
Old State Farmer Degree Applications

F. SUPPORTING REFERENCES

1. *Official FFA Manual*, Ref. No. 28.
2. *Robert's Rules of Order*, Ref. No. 90.
3. *Virginia FFA Activity Handbook*, Ref. No. 39.
4. *FFA Advisor's Handbook*, Ref. No. 25.

## V. BASIC HYDRAULICS

UNIT CONCEPT: The maintenance and repair of the hydraulic system components are important parts of the agricultural mechanics responsibility in a machinery repair shop. Proper service and maintenance of the hydraulic system will aid in avoiding problems such as the system operating slowly, foaming of oil in the system, oil loss, and cylinder seepage.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

The student should be able to:

1. Correctly diagnose the nature of malfunction following directions in the service manual, given equipment with maladjustments in the hydraulic system.
2. Change filter(s) and add oil, provided equipment with a hydraulic system.

B. INSTRUCTIONAL AREAS

1. Determining the major causes or sources of problems in the hydraulic system.
   a. Slow system operation
   b. Oil loss
   c. Cylinder seepage
2. Understanding hydraulic system components and their function
   a. Identifying the parts of the system
   b. Determining the functions of the parts
   c. Principles of operation in the hydraulic system
   d. Types of hydraulic systems
      1) Power-delivery systems
      2) Types of hydraulic systems
      3) Open-center hydraulic system
      4) Closed-center hydraulic system

5) Hydraulic system components
6) Hydraulic cylinders
7) Hydraulic motors

e. Characteristics of hydraulic oils

3. Inspecting and servicing the hydraulic system
   a. General maintenance procedures for the hydraulic system
   1) Determining why cleanliness is important when servicing the hydraulic system
   2) Keeping the external surfaces of the hydraulic system clean
   3) Changing filters in the hydraulic system
   4) Changing or adding oil to the hydraulic system
   5) Draining the hydraulic system
   6) Cleaning and flushing the system
   7) Filling the system with clean oil
   8) Checking the system for leaks and tightening loose connections
   9) Bleeding air from the system according to the manufacturer's directions

   b. Inspecting and servicing hydraulic lines and fittings
      1) Identifying defective hoses and tubing
      2) Removing defective hoses and tubing
      3) Installing the hoses and tubing in the hydraulic system

   c. Inspecting and servicing hydraulic cylinders
      1) Identifying and removing the defective cylinder
      2) Disassembling the cylinder
      3) Inspecting and replacing defective parts
      4) Replacing and installing O-rings
      5) Installing the seals and packing
      6) Reassembling the cylinders
      7) Installing the cylinders
      8) Checking the operation of the cylinder
      9) Bleeding remote cylinders

4. Analyzing the performance of hydraulic system
   a. Flow
   b. Pressure

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Have students observe the performance of a hydraulic system and list symptons of malfunctions identified.
2. Drain the hydraulic system, clean and flush the system with new hydraulic oil, drain the flushing oil, and refill the system with new oil and install clean filters.

3. Disassemble a remote cylinder, replace the "O" ring, replace the oil seal and packing, and reassemble the cylinder.

D. COMPETENCIES

1. Understanding the hydraulic system
   - Identify major sources of problems
   - Identify the components of a hydraulic system and relate their function
   - Relate the principles of operation
   - Identify the types of hydraulic systems
   - Determine hydraulic cylinder displacement
2. Maintaining the hydraulic system
   - Stop leaks in hydraulic systems
   - Drain, clean, flush and refill hydraulic systems
   - Change filters
   - Bleed air from the system
   - Service hydraulic pumps
   - Service hydraulic cylinders
   - Service hydraulic motors
3. Repairing the hydraulic system
   - Replace hydraulic lines
   - Disassemble and reassemble a hydraulic cylinder
   - Replace "O" rings
   - Replace fittings
   - Install seals and packing
   - Operate a hydraulic system tester
   - Test the performance of a hydraulic system

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. Various hydraulic systems for the students to repair
2. Specialized equipment recommended by the manufacturer for working on the hydraulic system inducting torque wrench, dial indicator, high and low pressure gauges, seal thimble, hydraulic testing unit, valve spring tester, tubing cutter flaring tool, tube bending tool
3. Appropriate hand tools necessary for servicing the hydraulic system
4. Hydraulic oil and clean cloth.
5. Examples of defective O-rings, seals, and packing for inspection by the students
6. Charts showing the components of the complete hydraulic system
7. Tubing and hoses

F. SUPPORTING REFERENCES

1. *Fundamentals of Service: Hydraulics*, Ref. No. 60.
2. *Mobile Hydraulics Manual*, Ref. No. 95.
3. Service Manuals for the equipment being repaired.
4. *Tractor Hydraulics*, Ref. No. 5.

## VI. MECHANICAL POWER TRANSFER SYSTEMS

UNIT CONCEPT: The adjustment, set-up, service and repair of mechanical power transfer systems on agricultural equipment necessitates that a person have an understanding and knowledge of transmission lubricants, power train operation, belts and pulleys, sprocket and chain drives, gears and bearings to perform the maintenance, repair and set-up tasks encountered with agricultural equipment.

A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

1. When provided with a service manual for a tractor equipped with a sliding gear transmission, power steering unit and hydraulic system, correctly determine the type of lubricants necessary for servicing the units.
2. When provided with a power unit with a clutch, the appropriate service manual and the necessary tools, be able to disassemble correctly, identify parts, reassemble and adjust the clutch mechanism.
3. Given a cutaway model, disassembled differential or an adequate visual of a differential, be able to identify correctly its parts, types of gears and explain how it works to transmit power to the wheels.
4. When given an implement which uses V-belt(s) and pulley(s) as a means of transmitting power, be able to determine correctly by approved procedures the correct width and length of a V-belt for a given application on this machine.

B. INSTRUCTIONAL AREAS

1. Identifying severe operating conditions
2. Identifying lubrication factors which can cause damge to gears
3. Selecting Transmission Lubricants
   a. Types of transmissions and lubrication requirements
      1) Standard Gear Type Transmission

2) Automatic-type transmission
3) Hydraulic assist transmissions

b. Selecting Gear Oils
1) Identifying viscosity requirements
2) Identifying service classification requirements

c. Selecting Automatic Transmission Fluids
1) Conditions under which lubricants must perform specific functions
2) Types of automatic transmission fluid
a) Type F
b) Dexron
c) Type A, Suffix A
3) Torque converter fluids
4) Hydrostatic drive fluids

d. Identifying Transmissions - Hydraulic fluids
1) Types of fluids:
a) Allis Chalmers A-25
b) Case TCH Fluid
c) Ford M2C41-A Fluid
d) International Harvester Hy-Trans B-6 Fluid
e) John Deere 303 Special Purpose Fluid
2) Properties of fluid types

e. Keeping Transmission Fluids Clean
1) Opening the container
2) Storing Fluids
3) Harmful effects of water

4. Understanding the operation of Power Trains
a. Understanding principles of clutch operation
1) Defining Clutch
2) Relating positions of clutch operation
a) Engaged
b) Disengaged
3) Identifying Types of Clutches
a) Friction
(1) Dry disk type
(2) Wet or hydraulic-type
b) Positive
(1) Ratchet and Pawl
(2) Overriding and Overrunning
(3) Belt tension

b. Understanding the operation of mechanical transmissions
1) Definition of transmission

2) Purposes of the mechanical transmission
   a) Select speed ratios for travel speed
   b) Change direction of travel of the machine
   c) Can serve as power source for PTO
3) Identifying types of mechanical transmissions
   a) Sliding gear
   b) Collar shift
   c) Synchromash

c. Understanding operation of hydraulic assist transmission
   1) Defining hydraulic assist transmission
   2) Parts of the hydraulic transmission
      a) Hydraulic clutches
      b) Gear train
         (1) Countershaft
         (2) Planatary
   3) Description of clutch operation
      a) Engaged position
      b) Disengaged position

d. Understanding operation of hydrostatic drive
   1) Defining hydrostatic drive
   2) Describing transmission operation

e. Operation of Torque Converter
   1) Definition
   2) Function of the torque converter
   3) Description of torque converter operation

f. Understanding operation of the differential
   1) Defining differential
   2) Purposes of the differential
   3) Describing differential operation

g. Understanding operation of the final drives
   1) Purpose of the final drive
   2) Location of the final drive
   3) Advantages of the final drives

h. Understanding the operation of Power Take-Offs
   1) Defining PTO
   2) Identifying types of Power Take-Offs
      a) Constant-running
      b) Independent

5. Repairing and/or Reconditioning Power Trains
   a. Disassembly procedures
   b. Cleaning components
   c. Examining components



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d. Determine economics of discarding or rebuilding components
e. Ordering parts
f. Reassembling or replacing parts
g. Adjusting components
h. Replace lubricants and check for leaks
i. Performance test unit operation

6. Understanding other power transfer systems
   a. Belts and pulleys
      1) Identifying types of belts and pulleys
         a) V-belt
         b) Flat belt
      2) Identifying materials of construction
         a) Wood
         b) Steel
         c) Cast iron
         d) Fiber
         e) Paper
      3) Determining size and speed of belts and pulleys
         a) Equation for pulley size or speed - $D \times S = d \times s$
         b) (length of V-belt) Equation for determining V-belt length $L = 2c + 1.57 (D \times d)$
         c) (length of Flat-belt) Steps in computing length of flat belts = $D-d/4c$
   b. Understanding sprocket wheels and chains as a means of power transmission
      1) Identifying types of sprocket chains
         a) Detachable link on hook link chain
         b) Pintle chain
         c) Roller chain
         d) Silent chain or chain belt
      2) Advantages of sprocket and chain power transmission
   c. Understanding gears as a mechanical power transfer system
      1) Identifying types of gears
         a) Spur
         b) Bevel spur
         c) Warm gear
         d) Hypoid
         e) Helical

7. Servicing related parts of mechanical power transfer system
   a. Removing, replacing and servicing bearings
      1) Identifying parts of bearings
      2) Describing bearing uses

a) Ball bearings
b) Roller bearings
3) Related bearing capacities
4) Bearing removal procedures
5) Cleaning and inspecting bearings
6) Lubricating bearings
7) Installing bearings
8) Identifying reasons for bearing failure

b. Servicing the Brake System
1) Relating types of braking operations
a) Mechanical brakes
b) Hydraulic brakes
(1) Power
(2) Trapped oil
2) Identifying methods used to obtain braking action
a) Band brakes
b) Shoe brake
c) Disc brakes
3) Adjusting brakes
a) Identify symptons of brakes being in need of adjustment
b) Adjusting mechanical disc brakes
c) Adjusting mechanical shoe brakes
d) Adjusting mechanical band brakes
e) Adjusting hydraulic brakes
(1) Bleeding hydraulic brakes
(2) Adjusting hydraulic brake push rods

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Student disassemble a tractor or power unit, remove the clutch plate, pressure plate and clutch release bearing, evaluate their condition and reassemble with new or original parts as needed and properly adjust clutch pedal free travel upon completion of the reassembly.
2. Using a tractor or another appropriate power unit, have each student service its transmission, differential and final drive by checking oil levels, draining, if applicable, clean magnetic drain plug(s) and replace transmission oil filter, and refill with proper amount and type of transmission fluid and/or gear oil as specified in operator's manual.
3. Provided with equipment utilizing chains to transmit power, have students adjust chain tension for the following kinds of drives:

a. Horizontal and inclined
b. Vertical, those subject to stock loading and reversal of operation
c. Those located on fixed centers

D. COMPETENCIES

1. Adjusting mechanical power transfer systems
   Adjust clutch free travel
   Adjust V-belt tension and speed
   Adjust flat belt tension and speed
   Adjust sprocket chain tension and speed
   Adjust brakes
2. Setting up mechanical power transfer systems
   Check transmission and final drive lubricants
   Check hydraulic fluids
   Test power unit for proper operation and correct as needed
3. Servicing mechanical power transfer systems
   Drain and replace transmission lubricants and filter(s)
   Grease and oil power unit at designated points
   Replace or refill final drive and hydraulic fluids
   Lubricate pulleys
   Oil chains
   Remove, clean, inspect, lubricate and install bearings
   Check and refill brake cylinder fluid
   Bleed brake lines
4. Repairing mechanical power transfer systems
   Disassemble, repair and reassemble tractor systems
   Remove, repair and install tractor clutch
   Disassemble, repair and reassemble tractor differential
   Replace V-belts
   Replace flat belts
   Remove, repair and replace sprocket wheels and chains
   Remove, and replace brake shoes, disc and bands
   Remove, repair and replace brake master cylinder

E. INSTRUCTIONAL MATERIALS

1. Samples of transmission lubricants and gear oils and hydraulic fluids
2. Sample parts of a tractor clutch
3. Samples of V-belts and flat belts
4. Samples chains used to transmit power
5. Samples of type of gears

6. Examples of types of bearings
7. Examples of types of brakes

F. SUPPORTING REFERENCES

1. *Tractor Maintenance Principles and Procedures,* Ref. No. 38.
2. *Tractor Mechanic,* Ref. No. 108.
3. *Fundamentals of Machine Operation: Preventive Maintenance,* Ref. No. 53.
4. *Mechanical Power Transfer Systems,* Ref. No. 83.
5. *Fundamentals of Service: Power Trains,* Ref. No. 61.

## VII. GASOLINE AND DIESEL ENGINE OVERHAUL

UNIT CONCEPT: The ability to overhaul engines will give an individual the understanding necessary to recognize and repair engine problems as they relate to agricultural power systems.

A. STUDENT PERFORMANCE OBJECTIVES

The student should be able to:

1. Identify and show ability to use tools and equipment involved in engine overhaul.
2. Develop the knowledge and skill to properly disassemble and reassemble an engine.

B. INSTRUCTIONAL AREAS

1. Reviewing fundamentals of engine operation
2. Reviewing engine troubleshooting
3. Equipment and tools used in engine overhaul
   a. Cleaning equipment
   b. Identifying and using tools and equipment
   c. Reconditioning tools and equipment
   d. Measuring tools
   e. Safety equipment
4. Engine disassembly procedures
5. Cleaning the components
6. Examining the components
   a. Cylinder Heads and Valve Train
      1) Valve and Head assembly - inspection
   b. Servicing Cylinder Heads
   c. Inspecting and servicing valves

1) Types of valves
2) Valve inspection
3) Servicing valves

d. Inspecting and servicing valve seats and guides
e. Inspecting camshafts assembly
1) Locating camshaft timing marks
2) Servicing camshafts
3) Selecting cam bearings

f. Cam Followers
1) Hydraulic
2) Solid
3) Servicing and inspection

h. Push Rods
1) Servicing and inspection

i. Timing Chain and Gears
1) Servicing and inspection

j. Valve Springs
1) Servicing and inspection

k. Rocker Arms
1) Servicing and inspection

7. Cylinder Blocks
a. Inspection
b. Cylinders
1) Cast cylinders
2) Cylinder sleeves

c. Removing ridge from cylinders
d. Removing cylinder liners
e. Cleaning the cylinder area
f. Reboring the cylinder
g. Deglazing liners and cylinders

8. Piston, Rings, and Pins
a. Parts of the piston
b. Purpose of the piston
c. Types and purposes of piston rings
d. Diagnosing failures
e. Cleaning
f. Servicing

9. Connecting Rods, Servicing

10. Crankshaft
a. Servicing and inspection
b. Lubrication

11. Main and Connecting Rod Bearings
    a. Using micrometers, plastigauge, and torque wrenches
    b. Bearing crush, locks, and spread
12. Lubrication Systems
13. Cooling Systems
14. Fuel Systems
15. Flywheel, Clutch and Throw Out
16. Determining economics of rebuilding or discarding engine or components
17. Ordering Parts
    a. Head
    b. Valves
    c. Valve seats
    d. Valve guides
    e. Rotators
    f. Camshaft
    g. Cam followers
    h. Push rods
    i. Valve springs
    j. Rocker arms
    k. Cylinder blocks
    l. Cylinder
    m. Pistons & pins
    n. Rings
    o. Connecting rods
    p. Crankshaft
    q. Gaskets
    r. Miscellaneous parts
18. Reassembling or replacing engine procedures
19. Tuning the engine
20. Break-in

C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. With students working in groups of 2 or 3, have each group rebuild an engine following all instructional and safety points.
2. Have students identify all engine parts.
3. Have students "practice" on old parts such jobs as grinding valves, honing cylinders, etc.
4. Give study questions on various sections of the engine.

D. COMPETENCIES

1. Overhauling a gasoline and/or diesel engine
   Remove engine from tractor
   Disassemble engine
   Identify engine type
   Measure engine for wear
   Determine economic feasibility of overhauling or discarding engine
   Clean and remove carbon from engine components
   Grind valves and seats

Replace or knurlize valve guides
Check cylinder head for warpage
Deglaze and hone cylinders
Replace sleeves
Recondition cam shaft
Install piston pins
Install crankshaft, rods and pistons
Install oil seals
Install timing gears and chains
Replace gaskets
Torque main bearings, rod caps and head bolts
Install oil pump
Remove, test and replace diesel injectors and pump
Install engine in chassis
Start, tune-up and break-in engine

E. INSTRUCTIONAL MATERIALS OR EQUIPMENT

1. Old engine parts
2. Sufficient engine jobs for each group to complete several overhauls
3. Sufficient shop tools and supplies for engine rebuilding

F. SUPPORTING REFERENCES

1. *Automobile Engine Overhaul*, Ref. No. 65
2. *Tractors and Their Power Units*, Ref. No. 10
3. *Mechanics' Engine Bearing Reference Manual*, Ref. No. 18
4. *Motors Truck Repair Manual*, Ref. No. 89
5. *Fundamentals of Service-Engines*, Ref. No. 58
6. *Service Manual for the Doctor of Motors*, Ref. No. 20
7. *Farm Gas Engines and Tractors*, Ref. No. 64
8. *Understanding and Measuring Horsepower*, Ref. No. 7
9. *For Better Gasoline Engine Overhaul*, Ref. No. 86

## VIII. ELECTRICAL APPLICATIONS FOR AGRICULTURAL EQUIPMENT

UNIT CONCEPT: Electricity is an important source of power with a broad range of applications in agriculture. The correct and safe use of electricity is essential to the modern agriculturalist.

## A. SUGGESTED STUDENT PERFORMANCE OBJECTIVES

The students will be able to:

1. Identify major uses of electricity as a source of power for agricultural machines.
2. Select correct electrical equipment for application in agricultural installations.
3. Install electrical equipment correctly.

## B. INSTRUCTIONAL AREAS

1. Identifying single phase vs. three phase electrical power
2. Understanding applications and economics of phase converters
3. Selecting electric motors
4. Caring and cleaning electric motors
5. Understanding the functions and applications of automatic electric controls.
   a. Time clocks
   b. Photo electric cells
   c. Limit switches
   d. Safety controls (GFI)
   e. Magnetic relays
   f. Thermostats
   g. Circuit breakers
   h. Humidistats
6. Identifying electrical applications in the farm center
7. Identifying electrical applications in materials handling
8. Selecting standby electricity generating equipment

## C. EXAMPLES OF STUDENT LEARNING ACTIVITIES

1. Survey the home farm for uses of electrical power
2. Connect automatic controls in electrical power
3. Determine the correct electric motor and controls for installation on a materials handling machine

## D. COMPETENCIES

1. Selecting electric motors
   Identify single phase or three phase power availability
   Determine horsepower requirement
   Determine voltage requirement and availability
   Determine type of motor enclosure required
   Determine RPM required for job
   Identify type of motor control required

2. Maintaining electrical agricultural equipment
   Remove and replace electric motors
   Service electric motors
   Disassemble, troubleshoot, repair, and reassemble electric motors
   Wire and install electric motor controls
   Install and service standby generating equipment
   Change rotation of electric motors
   Service and install electric motor devices
   Select and replace belts and pulleys
   Select and use portable ground fault interruptors

E. INSTRUCTIONAL MATERIALS

1. Common types of electric motors
2. Selected electrical controls
3. Wiring tools and supplies

F. SUPPORTING REFERENCES

1. *Electric Motors Selection - Protection - Drives*, Ref. No. 1
2. Suggestions for teaching electrical and basic controls used in Agricultural Production. Edison Electric Institute
3. Electric motors. (15 transparency masters) Iowa State University
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## LIST OF RECOMMENDED EQUIPMENT

| *Item* | *Quantity Needed* |
|---|---|
| **HAND TOOLS** | |
| Pinch bar set | 1 |
| Pry bar set | 1 |
| Wrecking bar | 1 |
| Battery service kit | 2 |
| Distributor head brush | 2 |
| Distributor head socket | 2 |
| Standard hand wire brush | 24 |
| Valve guide brush set | 1 |
| Bushing driver sets, 3/8" - 1 3/8" and 1 5/16" - 1 3/4" | 2 |
| Bushing inserter set | 1 |
| Camshaft bearing tool | 1 |
| Chisel and punch set | 5 |
| C-clamps - 4", 6", and 8" (4 of each size) | 12 |
| Clutch aligning tool | 1 |
| Cylinder sleeve puller with ratchet, handle, and adapter plates | 1 |
| Guide studs | 2 |
| Hammers - ball peen 1 1/2 lb., brass, plastic tip, blacksmith, curved claw, and riveting (2 of each) | 12 |
| Sledge hammer, 8 lb. | 1 |
| Ignition aligning tool | 2 |
| Magnetic pick up tool | 5 |
| Rubber mallet | 2 |
| Nut splitter | 5 |
| Oil seal installer set | 1 |
| Piston ring compressor 3 1/2" to 7" capacity | 2 |
| Ring groove cleaner 5" | 2 |
| Ring spreader 3/64" to 1/4" ring capacity | 2 |
| Brake spring pliers, standard and truck - (1 of each) | 2 |
| Slip joint pliers 5" | 6 |
| Diagonal cutting pliers 6" | 2 |
| Hose clamp pliers | 2 |
| Ignition pliers | 2 |
| Lineman's pliers 7" | 2 |
| Needle nose pliers 4 1/2" | 5 |
| Retaining ring pliers | 2 |
| Channel lock pliers | 5 |
| Spark plug terminal pliers | 2 |
| Vise grip pliers 7" | 5 |

| *Item* | *Quantity Needed* |
|---|---|
| Hydraulic hand press, 25 ton capacity | 1 |
| Gear pullers set | 1 |
| Bearing pullers set | 1 |
| Punches, tapered, pin, brass, set of each | 3 |
| Screw driver set | 1 |
| Off set ratchet screwdriver with slotted and phillips heads | 2 |
| Magnetic screw drive set | 1 |
| Socket set 3/4" drive with metric adapters | 1 |
| Socket set 1/2" drive with metric adapters | 6 |
| Spark plug socket set | 3 |
| Socket set 3/8" drive with metric adapters | 6 |
| Socket set 1/4" drive | 6 |
| Screw extractor set | 1 |
| Tool chest 2 drawer | 5 |
| Rolling cabinet 3 drawer | 5 |
| Valve guide cleaner 5/16" to 5/8" | 5 |
| Valve keeper inserter | 5 |
| Valve lapper - dual cup | 5 |
| Valve lapper - hand | 5 |
| Valve lapper suction cups | 2 |
| Valve spring compressor | 5 |
| Adjustable end wrenches, 4", 8", 12" (5 of each) | 15 |
| Allen wrench set | 5 |
| Allen wrench set - metric | 2 |
| Box end wrenches, 3/8" - 1 5/8" | 5 |
| Chain wrench 23" | 1 |
| Combination wrenches, 3/8" - 1 5/8" | 5 |
| Combination metric, 10mm - 32mm | 2 |
| Distributor lock nut wrench | 1 |
| Distributor lock nut wrench, 13mm | 1 |
| Ignition wrench set | 5 |
| Impact wrench with sockets, phillip & slotted screwdrive tips, 1/2" drive | 1 |
| Oil filter wrench | 1 |
| Open end wrenches, 1/4" - 1 5/8" | 5 |
| Pipe wrench set, 6" - 24" | 1 |
| Spanner, 3/4" to 2" | 2 |
| Striking wrench set - 1 1/4", 1 3/8", 1 1/2", 1 5/8", 1 3/4", 1 7/8" and 2" | 1 |
| Tappet wrench set, 7/16" - 7/8" | 1 |

## HOLE SIZING AND METAL CUTTING EQUIPMENT

| *Item* | *Quantity Needed* |
|---|---|
| Bolt cutter 36" | 1 |
| Cylinder Hone 2" - 7" complete with stones | 1 |
| Cylinder ridge reamer, 2" - 5" capacity | 1 |
| Drill bit sets 1/16" to 1/2" by 32nd | 2 |
| Drill bit 1/2" - 3/4" by 16th | 4 |
| Drill bits 13/16" - 1" by 16ths | 3 |
| Drill bits 1 1/8", 1 1/4", 1 3/8", 1 1/2" | 4 |
| Portable drill 3/8", reversing, various speed | 2 |
| Portable drill 1/2" reversing | 1 |
| Drill press, 17", variable speed, 1 hp., tilting table (complete with accesories) | 1 |
| Drill press vise 1 3/4" × 4" | 1 |
| Drill chuck, 3 jaw, 0 - 1/2" capacity | 1 |
| File sets | |
| Flat files 6", 8", 10", 12" and 16" | 2 |
| Round 6", 8", 10", 12", and 16" | |
| Points 5 1/4" × 5/16" × .044" | |
| Triangular 8" | |
| Square 8" | |
| File handles 4 9/16", 4 7/8", 4 3/6" | 10 ea. size |
| File card | 10 |
| Grinder bench 7" stones (complete w/accessories) | 1 |
| Grinder pedestal 12" stones (complete w/accessories) | 1 |
| Grinder, portable disc | 1 |
| Grinding wheel dresser | 1 |
| Hacksaw, hand (with blades) | 12 |
| Hollow punch set | 1 |
| Pipe cutter 1/8" × 2" | 1 |
| Pipe reamer | 1 |
| Pipe threader 1/2" to 2" | 1 |
| Reamer set | 1 |
| Shears, metal cutting | 1 |
| Snips, tinners (curved and straight) | 2 |
| Tap and die sets | 1 ea. |
| English | |
| Metric | |
| Spark plug thread chaser | |
| Tubing cutter 1/8" - 1 1/8" | 1 |
| Tubing flairing tool set | 1 |
| Valve shop | 1 |

## TESTING AND MEASURING DEVICES

| *Item* | *Quantity Needed* |
|---|---|
| Battery tester | 1 |
| Calipers, inside, outside (English measure) | 1 ea. |
| Calipers, vernier - English measure, 6" capacity | 4 |
| Calipers, vernier, metric 150 mm capacity | 1 |
| Calipers, vernier, inside, outside 6"/150mm capacity | 1 |
| Calipers, inside set - 4", 6", and 8" | 1 |
| Calipers, outside set - 4", 6" and 8" | 1 |
| Center gauge, 60° | 2 |
| Compression gauge | 2 |
| Current indicator | 2 |
| Crack detector, magnetic | 1 |
| Cylinder bone gauge | 1 |
| Depth gauge, micrometers, type | 2 |
| Dial indicator, .001 graduations (with base and magnetic holder) | 1 |
| Injector nozzle tester | 1 |
| Dividers, set 4", 6" and 8" | 1 |
| Drill gauge | 1 |
| Dynamometer | 1 |
| Engine analysis test equipment set | 1 |
| Feeler gauges | 10 |
| Growler, generator starter armature tester | 1 |
| Hydraulic system tester (complete with accessories) | 1 |
| Hydrometers, battery | 2 |
| Hydrometers, antifreeze | 2 |
| Level, 24" aluminum | 1 |
| Magneto ignition analyzer | 1 |
| Micrometers: | |
| Outside English 9-1" | 12 |
| Outside English 1-2", 2-3", 3-4", 4-5" | 1 |
| Outside metric 0-25mm | 1 |
| Outside metric 25-50mm | 1 |
| Outside metric 50-75mm | 1 |
| Inside English 2-8" | 1 |
| Oscilloscope engine analyzer | 1 |
| Radiator pressure tester | 1 |
| Radius gauge | 1 |
| Rules: | |
| Metal edge 24" | 15 |
| Push-pull, pocket, 12' | 15 |
| Meter stick, 100cm | 6 |

| *Item* | *Quantity Needed* |
|---|---|
| Screw pitch gauge | 4 |
| Spark plug gauge | 12 |
| Spring tester | 1 |
| Squares: | |
| Combination | 12 |
| Framing 24" | 4 |
| Try 6" blade | 4 |
| T-bevel, 6" blade | 4 |
| Steel tape: | |
| 100' | 1 |
| 50' | 1 |
| Straight edge, 18" | 1 |
| Tachometer | 1 |
| RPM speed indicator, hand held | 1 |
| Tap and drill gauge | 1 |
| Telescoping gauge 5/16" to 6" | 1 |
| D. C. circuit tester | 1 |
| A. C. circuit tester | 1 |
| Combustion analyzer | 1 |
| Vaccum fuel pump tester | 1 |
| Timing light | 6 |
| Tire pressure gauge: | 2 |
| Tire pencil gauge - 1 - 50 lbs. | 2 |
| Air liquid 10 - 50 lbs. | 2 |
| Truck tire 60 - 160 lbs. | 1 |
| Tire thread depth gauge | 2 |
| Torque wrench: | |
| 3/8" drive - 150 in-lbs. - 175 kg-cm. | 1 |
| 1/2" drive - 250 ft-lbs. - 35 kg-m. | 1 |

## LIFTING, BLOCKING AND HOLDING DEVICES

| | |
|---|---|
| A-frame hoist, 2 ton cap. | 1 |
| Jack stands, adjustable | 16 |
| Chain hoist, 2 ton cap. | 1 |
| Chain, towing 3/8" × 14' | 2 |
| Engine repair stand | 4 |
| Hydraulic jacks, 1 1/2 and 5 ton cap. | 2 ea. |
| Load adjuster sling | 1 |
| Load binder | 2 |
| Mobile floor crane, 4 ton capacity | 1 |

| *Item* | *Quantity Needed* |
|---|---|
| Portable floor crane, 1 ton capacity | 1 |
| "S" - hooks, lifting | 1 |
| Vice, machinist 4" jaws, 6" opening | 6 |
| Vice, pipe 1/8" - 2" capacity | 1 |
| **SMALL ENGINE TOOLS** | |
| Crankshaft wrench | 4 |
| Cylinder bore gauge 1 3/4" - 3 1/4" | 4 |
| Cylinder hone, 1 7/8" - 2/34" | 1 |
| Small engines: 4 cycle, vertical shaft | 1 |
| 4 cycle, vertical crankshaft | 1 |
| 4 cycle, horizontal crankshaft | 10 |
| 2 cycle | 1 |
| Small engine test stand, adjustable positioner | 12 |
| Small engines tool set, B & 5 No. 291661 or equivalent | 2 |
| Small engine tool - ZIM set or equivalent | 4 |
| Valve refacing lathe for small engines, hand operated | 1 |
| Valve seat cutter, small engines, hand operated | 1 |
| **CLEANING EQUIPMENT** | |
| Parts washer | 1 |
| High pressure washer | 1 |
| Shop vacuum cleaner - wet or dry | 1 |
| **AUXILLARY SHOP EQUIPMENT** | |
| Air compressor, 5 HP, 2 stage | 1 |
| Air compressor accessories: | |
| Hose 5/16" × 25' | 4 |
| Quick couplers, male & female | 10 |
| Hose coupling nipples | 4 |
| Air blow gun | 2 |
| Sand blast gun | 1 |
| Air chuck | 2 |
| Dual foot chuck | 1 |
| Pipe nipple | 4 |
| Anvil, 140 pound | 1 |
| Anvil stand | 1 |
| Battery charger | 1 |
| Booster cables, No. 3 gauge, 20' | 1 |
| Battery carrier strap | 2 |

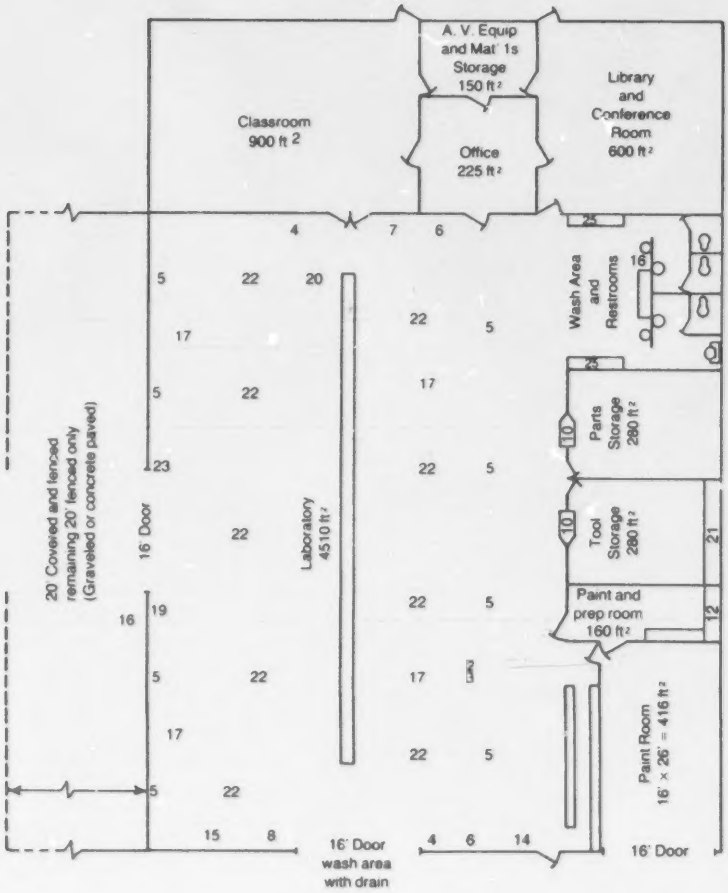
| *Item* | *Quantity Needed* |
|---|---|
| Battery filler | 2 |
| Extension cord, 25′ | 8 |
| Extension cord, 50′ | 1 |
| Extension cord, reel 29′ | 1 |
| Hydro-flater | 1 |
| Chassis lubrication unit, air operated | 1 |
| Gear lubrication unit, hydraulic operated | 1 |
| Portable drain ta. k | 1 |
| Drain pans | 6 |
| Grease gun, lever type | 2 |
| Grease fitting driver | 2 |
| Oiler, 1/2 pt. capacity | 2 |
| Pressure oiler, 5 oz. capacity | 6 |
| Hydraulic pump oiler, 1 pt. capacity, 9″ spout | 1 |
| Oil measures, 1 quart capacity | 2 |
| Suction gun, 20 oz. capacity | 2 |
| Paint spray respirator | 5 |
| Viscosimeter | 5 |
| Paint spray outfit: | 1 |
| Spray gun, suction feed | |
| Detachable stern for gun | |
| Suction feed cup | |
| Air hose with detachable coupling | |
| Oil and water extractor | |
| Angle adapter | |
| Duster gun and adapter | |
| Soldering iron, electric (3/8″ tip-100 watt and 7/8″ tip - 300 watt) | 2 ea. |
| Soldering gun, electric | 1 |
| Propane torch kits | 10 |
| Trouble light, 25′ | 10 |
| Arc welders, 295 amp. capacity | 4 |
| Welding helmets | 4 |
| Chipping hammers | 4 |
| Welding gloves, gauntlet | 12 |
| Welding apron | 4 |
| Welding clamps, vise grip type | 6 |
| Carbon arc torch | 4 |
| Welding cable extension | 1 |
| Oxyacetylene welding outfit (complete) | 1 |

## MISCELLANEOUS EQUIPMENT

| *Item* | *Quantity Needed* |
|---|---|
| Awls, scratch | 4 |
| Benches, 24" wall type | as needed |
| Paint brushes, 1", 2" and 4" | 4 ea. |
| Carbon brushes | 6 |
| Wire brushes | 12 |
| Bucket, 12 quart capacity | 2 |
| Storage cabinets | as needed |
| Tool storage cabinets, birch plywood, 4' × 4' | as needed |
| Tool pegboard, with hangers and hooks | as needed |
| Safety cabinets for paint and flammables | 2 |
| Oily waste can | 5 |
| Radiator refiller can | 1 |
| Safety can, 2 1/2 gallon capacity and 5 gallon capacity | 2 ea. |
| Chain link detacher | 1 |
| Clip board | 15 |
| Creeper | 2 |
| Desk, teachers | 1 |
| Engraving tool, electric | 1 |
| Funnels: | |
| Tractor lock-on | 1 |
| 1 pint capacity | 1 |
| 1 quart capcity | 1 |
| Canned oil dispenser | 1 |
| Staple gun | 1 |
| Curved claw hammers | 2 |
| Tire tool hammer | 2 |
| Hose, rubber 3/4" × 50' | 2 |
| Ignition simulator | 1 |
| Stepladder, 6 foot | 1 |
| Leather punch | 1 |
| Dust respirator | 2 |
| Pop rivet gun kit | 1 |
| Safety glasses monitor - complete 36 pairs of gloves | 1 |
| Safety face shields | 10 |
| Saws: | |
| Hand crosscut | 2 |
| Hand rip | 2 |
| Sabre saw kit | 1 |
| Portable circular saw | 1 |
| Floor scraper | 2 |

| *Item* | *Quantity Needed* |
|---|---|
| Shelving | as needed |
| Shovels, square point and round point | 1 ea. |
| Sickle bar tool | 1 |
| Floor squeegee | 2 |
| Letter stamping set | 1 |
| Number stamping set | 1 |
| Mechanics work stool | 4 |
| Tire tools: | |
| Removal tool | 2 |
| Rim tool | 2 |
| Valve tool | 2 |
| Portable metal work table | 4 |

# RECOMMENDED FACILITY PLANS

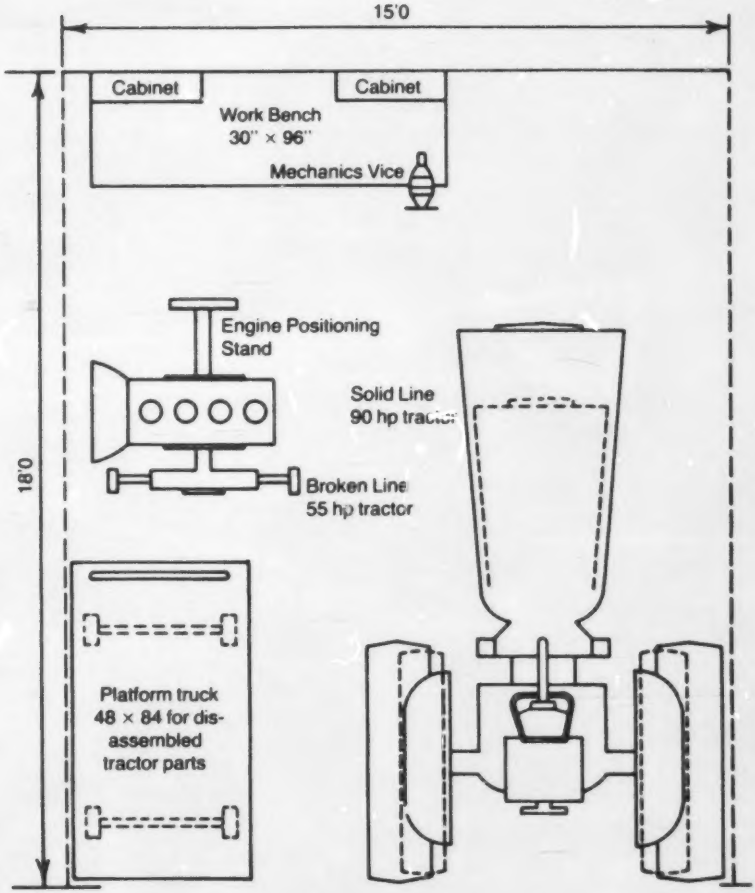

A. V. Equip and Mat'ls Storage 150 ft²
Library and Conference Room 600 ft²
Classroom 900 ft²
Office 225 ft²
Wash Area and Restrooms
Parts Storage 280 ft²
Tool Storage 280 ft²
Paint and prep room 160 ft²
Paint Room 16' × 26' = 416 ft²
Laboratory 4510 ft²
16' Door
20' Covered and fenced remaining 20' fenced only (Graveled or concrete paved)
16' Door wash area with drain
16' Door

*Numbers 1-25 on floor plan refer to permanent equipment recommended for an Agricultural Machinery Service facility. See next page for permanent equipment code.

## CODE FOR RECOMMENDED EQUIPMENT

Permanent Equipment -
1 - Work benches with lights
2 - Valve grinder
3 - Seat grinder
4 - Arc welders
5 - Electric drop reels
6 - Heavy grinder
7 - Drill press
8 - Parts washer
9 - Lube equipment
10 - Reference counter window
11 - Flammable storage
12 - Paint storage
13 - Air compressor
14 - Steam cleaner or high pressure washer
15 - Press
16 - Hot and cold water
17 - Retractable air coils
18 - Hardware storage bin
19 - Portable gas welding tanks
20 - Portable dynamometer
21 - Hydraulic test bench
22 - Floor exhaust system
23 - MIG welder
24 - Metal and wood storage racks
25 - Student lockers

## SUGGESTED WORKSTATION ARRANGEMENT FOR SMALL GASOLINE ENGINES AND TRACTORS



## RECOMMENDED INCLUSIONS FOR AN AGRICULTURAL MACHINERY SERVICE FACILITY

| | |
|---|---|
| Exhaust | — motor exhaust vents be installed in the concrete floor at each work station. |
| Floors | — laboratory floor be made of concrete with sufficient thickness to support weight of the heaviest load the facility will encounter. All concrete floors should be sealed. |
| Shop drains | — gutter type drains be provided with drainage into a settling basin. |
| Wash Area | — exterior concrete wash area be provided with drainage into the settling basin. |
| Walls | — height of walls 16' minimum<br>— be treated with epoxy paint or equivalent material for cleaning purposes. Treated area should be minimum of 7' high.<br>— color be light, example yellow, white, etc. |
| Doors | — equipment entrance doors be 16' wide and 14' high.<br>— exterior passage way doors be provided adjacent to equipment entrance doors.<br>— parts storage and tool - storage room doors be 42" wide. |
| Electrical Service | — minimum of 600 AMP service be provided<br>— master shut off switch be provided<br>— ground fault interrupters be wired into circuitry<br>— welding outlet be provided every 20-25 feet of wall space<br>— a 220 volt circuit be provided every 30 ft. of wall space or one circuit for each 2 work stations |
| Heat | — have provisions for independent heat control for the laboratory<br>— consider infared heaters |
| Lighting | — general lighting requirements for the laboratory 50-100 foot candles |
| Loading Ramp | — be provided and located outside the fenced in area with 360° access. |
| Hot Water | — be provided in hand washing and equipment cleaning areas |
| Compressed air | — outlets be located at 40' intervals around exterior walls |

| | |
|---|---|
| | — compressor be located in out of the way storage area |
| Safety Glasses | — storge and sanitary cabinet be located at the primary student entrance area of the laboratory |
| Roof strength | — roof trusses should be of sufficient strength to support chain hoists and other equipment for lifting tractors and farm equipment. |

# CRITERIA FOR QUALITY VOCATIONAL PROGRAMS IN AGRICULTURAL EDUCATION

## CRITERIA COMMON TO ALL PROGRAMS

### Instructional Program

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 1. The department's annual and five-year program plans, including goals, objectives, and activities, are on file in the department and with the administration.<br>* Observations and Recommendations: | | | |
| 2. A written statement of philosophy for vocational education in agriculture is on file and is in harmony with the philosophy statement for the total school.<br>* Observations and Recommendations: | | | |
| 3. The instructional program is reviewed and modified in accordance with local, state, and federal manpower data.<br>* Observations and Recommendations: | | | |
| 4. Validated competencies, needed by students for entry and advancement in employment, are utilized in developing objectives for the instructional program.<br>* Observations and Recommendations: | | | |
| 5. The instructional program contains the necessary balance of class time, laboratory work, field trips, and occupational experience to adequately prepare students for employment or advanced educational programs.<br>* Observations and Recommendations: | | | |

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 6. Students enrolled in vocational education in agriculture also are enrolled in other appropriate courses including science, mathematics, social science, and oral and written communications.<br>* Observations and Recommendations: | | | |
| 7. The instructional program is articulated with other local secondary, postsecondary, and four-year programs of education in agriculture.<br>* Observations and Recommendations: | | | |
| 8. Planned visits are made to prospective employers by the agriculture instructor or school placement officer to determine current employment needs.<br>* Observations and Recommendations: | | | |
| 9. Written courses of study and teaching calendars are based on validated competencies and are evaluated and revised annually.<br>* Observations and Recommendations: | | | |
| 10. Provisions are made to accommodate students with physical handicaps or other special educational needs.<br>* Observations and Recommendations: | | | |
| 11. Community resources, facilities, and industries are identified and utilized to enhance the quality of the instructional program.<br>* Observations and Recommendations: | | | |
| 12. Lesson plans are developed that clearly state instructional objectives, activities, and resources to be utilized during instruction.<br>* Observations and Recommendations: | | | |

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 13. Modern and technically accurate instructional materials and reference books are utilized in the instructional program.<br>* Observations and Recommendations: | | | |
| 14. Students have access to current agricultural publications.<br>* Observations and Recommendations: | | | |
| 15. Instruction in safety is provided in advance of any laboratory work.<br>* Observations and Recommendations: | | | |
| 16. Transportation is provided to students for all planned off-campus educational activities.<br>* Observations and Recommendations: | | | |
| **Supervised Occupational Experience**<br>17. Students are engaged in supervised occupational experienced programs that are related to their occupational objective and are appropriate in accordance with their ability and place of residence.<br>* Observations and Recommendations: | | | |
| 18. A systematic plan is utilized to select, develop, and evaluate training stations that assist students in obtaining desired occupational competencies.<br>* Observations and Recommendations: | | | |
| 19. The instructor, student, and employer cooperatively develop a formal training agreement and training plan which include essential competencies and experiences that are to be acquired during the program.<br>* Observations and Recommendations: | | | |

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 20. Students who are employed and participating in the occupational experience program are employed in accordance with all applicable federal and state laws.<br>* Observations and Recommendations: | | | |
| 21. The instructor provides effective coordination, supervision, and occupational guidance to students engaged in occupational experience programs.<br>* Observations and Recommendations: | | | |
| 22. Supervision of students, engaged in cooperative ocupational experience programs, is accomplished by both the instructor and the cooperating employer.<br>* Observations and Recommendations: | | | |
| 23. Agriculture instructors have at least one class preparation period and one period for supervision per instructional day.<br>* Observations and Recommendations: | | | |
| 24. Each instructor responsible for supervision of occupational experience programs maintains adequate records to determine student progress and to assist in placement.<br>* Observations and Recommendations: | | | |
| 25. Each student engaged in a supervised occupational experience program maintains accurate and up-to-date records including financial transactions and competencies acquired during the program.<br>* Observations and Recommendations: | | | |

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 26. Students receive (school) credit for all supervised occupational employment programs that are conducted during regular school hours.<br>* Observations and Recommendations: | | | |
| 27. A minimum of one on-site supervisory visit per month is made by the instructor to each employer and student enrolled in a cooperative educational training program.<br>* Observations and Recommendations: | | | |
| 28. A minimum of four (4) supervisory visits will be made to each student enrolled in agricultural education.<br>* Observations and Recommendations: | | | |
| **Leadership Development**<br>29. All secondary agriculture students are members and participate in the Future Farmers of America (FFA).<br>* Observations and Recommendations: | | | |
| 30. All agriculture students who are enrolled in young farmer instructional programs are members and participate in the Young Farmer Association.<br>* Observations and Recommendations: | | | |
| 31. The local FFA Chapter and YFA involve members in activities at the district, state and national levels.<br>* Observations and Recommendations: | | | |
| 32. Leadership development activities are an integral part of the instructional program.<br>* Observations and Recommendations: | | | |

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| **Student Recruitment, Enrollment and Counseling** | | | |
| 33. Students enrolling in an option of agriculture should have completed a two-year basic vocational agriculture program.<br>* Observations and Recommendations: | | | |
| 34. Prospective students and their parents are visited by the agriculture instructor and provided copies of the program objectives prior to their enrollment in the program.<br>* Observations and Recommendations: | | | |
| 35. A student file is maintained for all students and contains current information such as occupational objectives, supervised occupational experience programs, FFA activities and course work.<br>* Observations and Recommendations: | | | |
| 36. The agriculture instructor advised each student on a regular basis and assists those with special educational and personal needs to obtain additional assistance from qualified school personnel.<br>* Observations and Recommendations: | | | |
| **Public Relations** | | | |
| 37. Through an effective public relations program the faculty, students, parents, employers, advisory council members, and the community understand the educational objectives, major objectives and accomplishments of the agriculture program.<br>* Observations and Recommendations: | | | |
| 38. The instructors establish and maintain cooperative working relations with leaders in related industries, organizations, and agencies.<br>* Observations and Recommendations: | | | |

| Facilities and Equipment | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 39. The classrooms and laboratories are adequate for the number of students enrolled. The equipment is appropriate for that found in the occupations for which training is provided.<br>* Observations and Recommendations: | | | |
| 40. Facilities and equipment meet all current state and federal safety regulations.<br>* Observations and Recommendations: | | | |
| 41. Classrooms and laboratories are maintained in an orderly, safe and attractive condition.<br>* Observations and Recommendations: | | | |
| 42. Facilities and equipment are arranged with consideration given to effective teaching, class control, safety and economy.<br>* Observations and Recommendations: | | | |
| 43. A land laboratory, convenient to the school, is provided and utilized in the instructional program.<br>* Observations and Recommendations: | | | |
| 44. The departmental office is situated to provide optium supervision.<br>* Observations and Recommendations: | | | |
| 45. Supplies and equipment are stored in a systematic and safe manner.<br>* Observations and Recommendations: | | | |
| 46. Maintenance and service records of equipment are on file in the department office.<br>* Observations and Recommendations: | | | |

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 47. Facilities are designed to meet or exceed the recommendations of the State Department of Education. The teachers of agricultural education in the school district are involved in the planning of the facilities.<br>* Observations and Recommendations: | | | |
| **Staffing** | | | |
| 48. The instructor possesses the personal, technical, professional and occupational competencies necessary to prepare students for entry level employment or for advanced educational programs.<br>* Observations and Recommendations: | | | |
| 49. The instructor is sensitive to the needs of students and can recognize and make provisions for individual student differences withing the instructional program.<br>* Observations and Recommendations: | | | |
| 50. Instructors are employed on twelve-month contracts to provide for continuous education and supervision of students during summer months.<br>* Observations and Recommendations: | | | |
| 51. The maximum assignment per instructor is 20 hours of classroom instructional time, five hours of student advising, and fifteen hours of supervision and preparation per week.<br>* Observations and Recommendations: | | | |
| 52. The instructor is actively involved in professional teacher organizations which are supported by agricultural educators in the state, and is engaged in continuing in-service professional development programs.<br>* Observations and Recommendations: | | | |

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 53. At least one instructor in the department holds a current Red Cross first aid card or its equivalent.<br>* Observations and Recommendations: | | | |
| 54. The department has access to adequate secretarial services.<br>* Observations and Recommendations: | | | |
| 55. Instructors holding collegiate certification will acquire full collegiate professional certification within three years of original employment.<br>* Observations and Recommendations: | | | |
| **Administration and Supervision** | | | |
| 56. The agriculture program is an integral part of the local school division plan for vocational education.<br>* Observations and Recommendations: | | | |
| 57. The instructor participates in a minimum of four weeks of professional improvement activities every three years.<br>* Observations and Recommendations: | | | |
| 58. Representatives of local, area, and state education agencies participate in planning the program of instruction and are kept informed of the progress made.<br>* Observations and Recommendations: | | | |
| 59 In multiple-instructor departments, one instructor is appointed and compensated to serve as department head. Job descriptions are on file for all department staff members.<br>* Observations and Recommendations: | | | |

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 60. An agriculture advisory council or committee is formed and meets at least twice a year to help determine program needs and to assist in promotion, and evaluation of the program.<br>* Observations and Recommendations: | | | |
| 61. The advisory council functions under written guidelines which specify the length of a member's term, responsibilities, and operational procedures.<br>* Observations and Recommendations: | | | |
| 62. An advisory committee for the total agricultural education program is active. Members of the advisory committee serve as an advisory committee to specialized program in agricultural education.<br>* Observations and Recommendations: | | | |
| **Finance**<br>63. The instructional program is supported by an annual board-approved budget that considers program needs and the number of students enrolled. Included are:<br>a. Staff compensation on year-round basis<br>b. Staff compensation for program of continuing education<br>c. Facility operation and maintenance<br>d. Equipment and material purchase and replacement<br>e. Consumable supplies<br>f. Teacher travel and per diem<br>g. Transportation for field trips<br>h. In-service education<br>* Observations and Recommendations: | | | |

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 64. Appropriate and accurate financial records are maintained. Administration and/or board-approved policies are provided for the receipt and disbursement of funds.<br>* Observations and Recommendations: | | | |
| **Placement**<br>65. The instructor, in cooperation with the school counselor, assists in the placement and follow-up of students. A file of placement and employment records is maintained.<br>* Observations and Recommendations: | | | |
| **Evaluation**<br>66. The instructor, local administrator(s), and appropriate state education agency staff member(s) meet at regular intervals to formally examine and evaluate the agriculture program using these standards in connection with the annual self-evaluation.<br>* Observations and Recommendations: | | | |
| 67. One and five year follow-up surveys of former students are conducted to determine their current occupational or educational status.<br>* Observations and Recommendations: | | | |
| 68. Results obtained from program evaluations are used to promote, develop, and improve the instructional program.<br>* Observations and Recommendations: | | | |
| **Adult Education in Agriculture**<br>CRITERIA COMMON TO ADULT EDUCATION ARE LISTED UNDER THE SEPARATE HEADING OF "ADULT EDUCATION IN AGRICULTURE" | | | |

## CRITERIA SPECIFIC TO AGRICULTURAL MACHINERY SERVICE*

## SECONDARY

| Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|

### Supervised Occupational Experience

1. The minimum time spent by secondary students each year on occupational experience in agricultural machanics in addition to regular class and laboratory instruction approximate the following:

   | | |
   |---|---|
   | Agriculture Machinery Service III | 200 hours |
   | Agriculture Machinery Service IV | 300 hours |
   | Agriculture Machinery Service V | 300 hours |

   * Observations and Recommendations:

### Facilities and Equipment

2. Facilities are designed and used only for agricultural mechanics instruction.

   * Observations and Recommendations:

3. Agricultural facilities include a self-contained unit, which houses classrooms, laboratories, offices, storage, library and complementary auxiliary features.

   * Observations and Recommendations:

4. A minimum of 300 square feet of laboratory space is provided per student.

   * Observations and Recommendations:

5. The laboratory has a minimum width of 50 feet and a width-length ratio of not more than 1 to 2, permitting an open space concept.

   * Observations and Recommendations:

6. Adequate student lockers, restrooms, and clean-up facilities are provided.

   * Observations and Recommendations:

*these Criteria are to be used in conjunction with the "Criteria Common to All Programs."

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 7. The minimum square footage devoted to agricultural mechanics instruction is:<br>*Area*<br>Office 120<br>Classroom 600<br>Classroom storage 120<br>Mechanics Laboratory 450C<br>* Observations and Recommendations: | | | |
| 8. The main entrance to the agricultural mechanics laboratory is a minimum of 14 feet high and 14 feet wide.<br>* Observations and Recommendations: | | | |
| 9. Recommended lighting and ventilation are provided. The lighting meets the following specifications:<br>75-100 ft. candles in general and welding areas<br>120-150 ft. candles over work benches.<br>* Observations and Recommendations: | | | |
| 10. Adequate library, outside storage areas, and locker space are provided.<br>* Observations and Recommendations: | | | |
| 11. Tools and equipment are modern and comparable to those used in agriculture/agribusiness.<br>* Observations and Recommendations: | | | |
| **Staffing**<br>12. The student-instructor ratio does not exceed 15 students per class period for laboratory and occupational experience supervision.<br>* Observations and Recommendations: | | | |

| | Exceeds Stand. | Meets Stand. | Does Not Meet Stand. |
|---|---|---|---|
| 13. Agricultural mechanics instructor(s) is/are limited to four hours of class or laboratory per day.<br>* Observations and Recommendations: | | | |
| 14. Each instructor teaches not more than four different subjects per day.<br>* Observations and Recommendations: | | | |
| 15. Each instructor had a minimum of one hour per instructional day for preparation and counseling, and one hour for supervision.<br>* Observations and Recommendations: | | | |